**USACE CONTRACT NO. DACW33-03-D-0006**
**TASK ORDER NO. 0003**
**TOTAL ENVIRONMENTAL RESTORATION CONTRACT**

# DRAFT
# FIVE-YEAR REVIEW REPORT
# FOR
# SILRESIM SUPERFUND SITE
# Lowell, Massachusetts

**July 2004**

Prepared for

U.S. Army Corps of Engineers
New England District
Concord, Massachusetts

2004-JV03-0013
7/27/04

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Prepared by

Tetra Tech FW, Inc.
133 Federal Street
Boston, Massachusetts 02110

2004-JV03-0013
7/27/04

# Five-Year Review Report
# for
# Silresim Superfund Site
# City of Lowell
# Middlesex County, Massachusetts

## September 2004

**Prepared by**

**United States Environmental Protection Agency**
**Region I**
**Boston, Massachusetts**

Approved by:

Susan Studlien
Director
Office of Site Remediation and Restoration
U.S. EPA Region I

Date: 09/09/04

2004-JV03-0017
9/1/04

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## Acronyms

| | |
|---|---|
| ARARs | Applicable or Relevant and Appropriate Requirements |
| BAV | Benchmark Assessment Value |
| bgs | below ground surface |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CFR | Code of Federal Regulations |
| COCs | Contaminants of Concern |
| COPC | Chemicals of Potential Concern |
| CSF | Cancer Slope Factors |
| CUGs | Cleanup Goals |
| EPA | U.S. Environmental Protection Agency |
| ERH | Electrical Resistance Heating |
| ESD | Explanation of Significant Differences |
| EW | extraction wells |
| gpm | gallons per minute |
| GWTP | Groundwater Treatment Plant |
| GZA | Goldberg-Zoino & Associates, Inc. |
| HDPE | high density polyethylene |
| IRIS | Integrated Risk Information System |
| LI&S | Lowell Iron & Steel |
| MADEQE | Massachusetts Department of Environmental Quality Engineering |
| MADWPC | Massachusetts Department of Water Pollution Control |
| MADEP | Massachusetts Department of Environmental Protection |
| MCLs | Maximum Contaminant Levels |
| MCP | Massachusetts Contingency Plan |
| mg/Kg | milligrams per kilogram |
| MOM | Management of Migration |
| MRS | Metals Removal System |
| NCEA | National Center for Environmental Assessment |
| NCP | National Oil and Hazardous Substances Pollution Contingency Plan |
| NPL | National Priorities List |
| O&M | Operations and Maintenance |
| OUs | Operable Units |
| PAHs | Polycyclic Aromatic Hydrocarbons |
| PCBs | Polychlorinated Biphenyls |
| POTW | Publicly Operated Treatment Works |
| PPE | personal protection equipment |
| ppm | parts per million |
| PRPs | Potentially Responsible Parties |

| | |
|---|---|
| RAOs | Remedial Action Objectives |
| RCRA | Resource Conservation and Recovery Act |
| RCs | Reportable Concentrations |
| RfC | Reference Concentration |
| RfD | Reference Dose |
| RI/FS | Remedial Investigation/Feasibility Study |
| ROD | Record of Decision |
| SVE | Soil Vapor Extraction |
| SVOCs | Semivolatile Organic Compounds |
| TCE | Trichloroethene |
| TCLP | Toxicity Characteristic Leaching Procedure |
| TtFW | Tetra Tech FW, Inc. |
| TTO | total toxic organics |
| UCL | Upper Concentration Limit |
| ug/L | micrograms per liter |
| USACE | U.S. Army Corps of Engineers |
| VOCs | Volatile Organic Compounds |

## Executive Summary

The remedy for the Silresim Superfund Site in Lowell Massachusetts includes the extraction and treatment of contaminated groundwater, construction of a low-permeability temporary cover followed by construction of a RCRA C type cap, excavation and stabilization of off-property soils under the RCRA C cap, operation of soil vapor extraction system to reduce the VOC source term, and implementation of appropriate institutional controls. The Groundwater Treatment Plant has been operational since construction was completed in November 1995. Excavation of contaminated off-site soils is scheduled for completion by Fall 2004. Construction of the RCRA C cap is scheduled for 2005. Soil vapor extraction (SVE) was implemented at the Site for 14 months beginning in October 1998. A final decision regarding whether or not to implement additional SVE at the Site is pending. The trigger for this second Five-Year Review was the submission of the first Five-Year Review in September 1999.

This Five-Year Review has found that those components of the remedy that have been constructed, to date, are consistent with the requirements of the Record of Decision (ROD). The GWTP is basically functioning as designed. However, a component of the groundwater plume has migrated past the extraction well array, due to some limitations in the original design of the array. Therefore, significant modifications have been made in the groundwater extraction well system and its operation, to more effectively contain the plume and enhance protectiveness. The plume is now believed to be largely contained. One Explanation of Significant Differences (ESD) was issued in September 2003. This ESD was issued to revise certain cleanup goals for the Site, in part, to reflect a State of Massachusetts reclassification of the groundwater in the Site area. The groundwater at the Site is no longer being considered a potential drinking water source. The ESD also established two operable units (OUs) for the Site. To facilitate documenting cleanup activities, OU 1 was defined as groundwater and SVE Phase I activities and OU 2 was defined as other source control activities.

The overall remedy is expected to be protective when groundwater cleanup goals in the source area are achieved. However, the time required to achieve groundwater cleanup, utilizing only groundwater extraction in these areas, is estimated to be much longer than 30 years. In the interim, institutional controls will be required across impacted Site areas, to ensure protectiveness.

# Five-Year Review Summary Form

| SITE IDENTIFICATION | | |
|---|---|---|
| **Site name (*from WasteLAN*):** Silresim Chemical Corp. | | |
| **EPA ID (*from WasteLAN*):** MAD000192393 | | |
| **Region:** I | **State:** MA | **City/County:** Middlesex |
| **SITE STATUS** | | |
| **NPL status:** ☒ Final ☐ Deleted ☐ Other (specify) | | |
| **Remedial status** (choose all that apply): ☒ Under Construction ☒ Operating ☐ Complete | | |
| **Multiple OUs?*** ☒ YES ☐ NO | **Construction completion date:** __ / __ / _____ Ongoing | |
| **Has site been put into reuse?** ☐ YES ☒ NO | | |
| **REVIEW STATUS** | | |
| **Lead agency:** ☒ EPA ☐ State ☐ Tribe ☐ Other Federal Agency _____ | | |
| **Author name:** Chet Janowski | | |
| **Author title:** EPA RPM | **Author affiliation:** EPA Region I | |
| **Review period:**** 9 / 29 / 1999 to 9 / 29 / 2004 | | |
| **Date(s) of site inspection:** 6 / 8 / 2004 | | |
| **Type of review:** ☒ Post-SARA ☐ Pre-SARA ☐ NPL-Removal only ☐ Non-NPL Remedial Action Site ☐ NPL State/Tribe-lead ☐ Regional Discretion | | |
| **Review number:** ☐ 1 (first) ☒ 2 (second) ☐ 3 (third) ☐ Other (specify) | | |
| **Triggering action:** ☐ Actual RA On-site Construction at OU #___ ☐ Actual RA Start at OU# __ ☐ Construction Completion ☒ Previous Five-Year Review Report ☐ Other (specify) | | |
| **Triggering action date *(from WasteLAN)*:** 9 / 29 / 1999 | | |
| **Due date *(five years after triggering action date)*:** 9 / 29 / 2004 | | |

* [OUs refer to operable unit.]
** [Review period should correspond to the actual start and end sates of the Five-Year Review in WasteLAN.]

## Five-Year Review Summary Form, cont'd

**Issues:**

The remedy will not achieve ROD and ESD mandated cleanup goals (CUGs) within time frames anticipated by the ROD. Time frames to achieve cleanup goals are anticipated to be much longer than 30 years.

It is anticipated that in the absence of significant additional VOC source term remediation, the groundwater treatment plant will have to remain in operation and institutional controls remain in effect indefinitely (much longer than 30 years) relative to certain areas of the Site, to ensure protectiveness.

A substantive component of the groundwater plume has migrated beyond the extraction well array, although the groundwater plume now appears to be largely contained.

Due to the large mass and high concentrations of VOCs remaining in the groundwater plume and also the need to simultaneously maintain plume capture to ensure protectiveness, the treatment plant is operationally constrained. Therefore, the treatment plant operations cannot be easily modified to accelerate reduction of the VOC source term and significantly expedite achievement of the mandated CUGs.

**Recommendations and Follow-Up Actions:**

Efforts should continue to refine groundwater treatment plant operation to optimize the operational balance between groundwater plume containment and groundwater source term removal.

Groundwater and air/vapor monitoring should continue across the Site and downgradient to evaluate potential future plume migration, possible vapor intrusion into buildings, and any associated risk of adverse impacts.

Consideration should be given toward developing a plan to collect data relevant to assess future natural attenuation in downgradient portions of the groundwater plume beyond the extraction well array.

**Protectiveness Statement(s):**

All immediate threats to the Site are being addressed and the remedy is expected to be protective of human health and the environment after groundwater cleanup goals are achieved through continued operation of the groundwater treatment plant. However, time frames to achieve CUGs are anticipated to be much longer than 30 years.

**Long Term Protectiveness:**

Long term protectiveness of the remedial action will be verified by continuing the ongoing groundwater and air/vapor monitoring programs, both on the Silresim property and in downgradient areas. Portions of the plume have migrated beyond the extraction well array and are being closely monitored. Current monitoring data indicate that the effectiveness of the extraction well array has been improved and that the plume is now largely contained. Current data also indicate that the remedy is functioning as required but will require much longer than 30 years to achieve CUGs.

**Other Comments:**

Proposed reductions in the toxicity values for certain key site contaminants (to reflect greater potential toxicity, particularly for TCE) that are currently under consideration could result in the CUGs for these contaminants appearing not to be protective and requiring further reduction. This would significantly increase the estimated times to achieve CUGs at the Site.

# Silresim Superfund Site
# Lowell, Massachusetts
# Second Five-Year Review Report

## I. Introduction

EPA Region I has conducted the second Five-Year Review for groundwater at the Silresim Superfund Site (Silresim) in the town of Lowell in Middlesex County, Massachusetts. This review was conducted from June 2004 to September 2004. This report documents the results of the review. Technical support for the preparation of this review has been provided by the U.S. Army Corps of Engineers (USACE) and its contractor, Tetra Tech FW, Inc. (TtFW).

The purpose of a Five-Year Review is to determine whether the remedy at a site is protective of human health and the environment. The methods, findings, and conclusions of a review are documented in a Five-Year Review Report. In addition, Five-Year Review Reports identify deficiencies found during the review, if any, and identify recommendations to address them.

This review is required by statute. EPA must implement Five-Year Reviews consistent with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). CERCLA §121(c), as amended, states:

> "If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented."

The NCP, in Part 300.430(f)(4)(ii) of the Code of Federal Regulations (CFR), states:

> "If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action."

This is the second Five-Year Review for the Silresim Superfund Site. The triggering action for this review was the completion of the first Five-Year Review for the Silresim Site in September 1999. Due to the fact that hazardous substances, pollutants, or contaminants remain at the Site above levels that allow for unrestricted use and unlimited exposure, the Five-Year Review is required.

In conducting this Five-Year Review, relevant existing documents related to project objectives, cleanup goals, and implementation of the remedial actions at the Site have been examined. The primary documents that have been reviewed include:

- EPA Five-Year Review Guidance Document (June 2001);
- Record of Decision (ROD) (September 1991) for the Silresim Site;
- First Silresim Five-Year Review (September 1999);
- Explanation of Significant Differences (September 2003) for the Silresim Site;
- Baseline Groundwater Monitoring Report (May 1996);
- ROD Remedy Review Report (July 1999);
- Groundwater Monitoring Status Reports [Reports #1 - #24](1996-2004);
- Site Investigation and Revision of Site Cleanup Goals Report (January 2002);
- Electrical Resistance Heating Pilot Test Final Report (September 2003); and
- Management of Migration and Source Removal Strategy Report (June 2000).

A comprehensive list of all of the documents that have been reviewed during preparation of this report is presented in Attachment 3.

This Five-Year Review has been prepared in accordance with the recent EPA guidance document: Comprehensive Five-Year Review Guidance (EPA, June 2001). The report reflects the fact that both groundwater and soil remediation are still ongoing at the Silresim Site. The Explanation of Significant Differences (ESD) promulgated in September 2003 created two Operable Units (OUs) for the Silresim Site. This Five-Year Review summarizes the status of both OUs.

## II. Site Chronology

**Table 1. Chronology of Site Events**

| Event | Date |
|---|---|
| Facility used as oil and fuel storage depot. | 1916-1971 |
| Facility used for chemical waste reclamation and later for hazardous waste collection and treatment by Silresim Chemical Corporation. MADWPC (now MADEP) inspections find repeated permit violations, attempts to shutdown Silresim. | 1971-1977 |
| Silresim bankrupt, facility abandoned, leaving one million gallons of hazardous materials on-site in drums, tanks and tanker cars. | 1978 |
| Over 30,000 drums were removed from the Site. | 1981-1982 |
| Facility listed on National Priorities List by USEPA for long term cleanup. | 1983 |
| Site structures removed, security fence extended, and clay cap placed over the Site. | 1984 |
| Remedial Investigation/Feasibility Study (RI/FS) process initiated by 185 PRPs (Silresim Site Trust). | 1985 |
| Remedial Investigation/Feasibility Study Report and Risk Assessment completed. | 1990 |
| Record of Decision (ROD) issued by USEPA. | 1991 |
| USACE/EPA/MADEP begin construction of Groundwater Treatment Facility with Foster Wheeler Environmental Corporation. | 1994 |
| Groundwater Treatment Facility begins continuous operation. | 1995 |
| Soil Vapor Extraction Pilot Test completed. | 1996 |
| Cap upgrade and drainage improvements completed. | 1998 |
| State determination that the groundwater is not suitable as a drinking water source. | 1998 |
| Phase I Soil Vapor Extraction Operations completed. | 1998-1999 |
| ROD Remedy Review and Five-Year Review completed recommending amendments to Cleanup Goals and remedial actions. | 1999 |
| Additional Site Investigation and Revision of Site Cleanup Goals completed. | 2001 |
| ERH Pilot Test completed. | 2002-2003 |
| Explanation of Significant Differences (ESD) completed. | 2003 |
| Design for Off-Silresim Property Soil Excavations completed. | 2004 |

## III. Background

### Physical Characteristics

The Site is located at 86 Tanner Street in an industrial area of Lowell, Massachusetts, approximately one mile south of the central business district (see Attachments 1 and 2). The original facility (Silresim Chemical Corporation) consisted of approximately 4.5 acres (Silresim Property). However, the National Priorities List (NPL) geographically defines the Silresim Site (the Site) as the extent of contamination that includes approximately 16 acres containing groundwater contamination and seven acres of soil contamination (EPA, 1991). The 4.5-acre former Silresim Property is bordered by the Lowell Iron and Steel Company to the north, the B&M railroad yard and tracks to the east/northeast, an automobile salvage yard to the south, and Tanner Street to the west. Residential areas are located south, east, and northeast of the Silresim property, with the closest residences located on Canada, Main, and Maple Streets, roughly 300 to 500 feet from the Silresim Property boundary. River Meadow Brook flows approximately 400 feet west of the Silresim Property boundary.

### Land and Resource Use

The Site and its immediately surrounding areas have been used for industrial activities since the early 1900's. From 1916 to 1971, several petroleum companies used the Site as an oil and fuel storage depot. Adjacent parcels have contained oil storage terminals, a foundry, steel fabrication equipment, a sales facility for used auto parts, coal storage facilities and railroad operations. From 1971 through 1977, the Silresim Chemical Corporation operated a chemical waste reclamation facility on the Site. The facility's primary operations included recycling and reclaiming various chemicals and consolidating wastes for off-site disposal. Wastes were accepted at the Site in drums, tank trucks, railroad tanker cars, and other containers. These substances included halogenated solvents, oily wastes, alcohols, plating wastes, metal sludges and pesticide wastes. The 1991 Record of Decision (ROD) estimated that the facility handled approximately three million gallons of waste per year.

The current land use for the area surrounding the Silresim Site continues to include commercial, industrial, and residential properties. The groundwater treatment plant (GWTP) is the only facility on the Silresim property itself. Remaining portions of the Silresim Site are covered by a temporary clay cap. The Silresim property is enclosed by a six-foot chain link fence with locked gate access. Active commercial/industrial facilities surround this property with residential housing primarily to the south of the Site. The small East Pond wetland area lies immediately southeast of the Silresim property. EPA and the City of Lowell are currently exploring possible future uses of portions of the overall Silresim Site, some of which might include certain recreational uses.

Groundwater beneath the Silresim Site is not currently used for drinking water. In addition, MADEP has recently reclassified the aquifer in the Site area as being one of "Limited Use and Value." The dominant direction of groundwater flow is toward the north and northwest. Subsequent flow is impacted by the presence of multiple municipal sewer lines. River Meadow Brook, located to the north of the Site, is believed to be one potential surface water discharge point for site groundwater.

### History of Contamination

The Silresim Chemical Corporation filed for bankruptcy in late 1977 and abandoned the Site in January 1978, leaving approximately one million gallons of hazardous materials on-site in drums and bulk tanks. Almost 30,000 decaying drums remained on the property covering virtually all open areas of the Site. Investigations revealed that the Site had been poorly maintained and revealed evidence of numerous spills, leakage of drums, discharges to Lowell sewers, and runoff to adjacent property.

As discussed in the RI (Goldberg-Zoino & Associates, Inc. (GZA), 1990), a variety of volatile organic compounds (VOCs), semivolatile organics (SVOCs), and metals were identified in surficial soils at the Site, concentrations of which varied depending upon site location. VOCs were relatively widespread including portions of the Silresim Property, the former Arrow Carrier Property (to the south of the Silresim Property), and localized areas of the Lowell Iron and Steel Property. SVOCs including PAHs, phthalates, PCBs, chlorinated benzenes and dioxins were elevated at the southern end of the Silresim Property and portions of the Lowell Iron and Steel Property. Some elevated metals concentrations were observed, primarily in the southeastern portion of the Silresim Property. In unsaturated subsurface soils down to approximately 6-10 feet below ground surface (bgs), VOCs were the primary contaminants that were observed. Total VOC concentrations in unsaturated soils across the Site were generally found to range from 100 to 1,000 mg/kg. In addition to VOCs, a number of SVOCs including phthalates, PAHs, and chlorinated benzenes were reported in localized areas with maximum concentrations in the 10-500 mg/kg range. Metals including arsenic, chromium, copper, lead, and mercury were also sporadically detected at elevated concentrations.

In the RI, VOCs were identified as the predominant chemical contaminants that were (and continue to be) detected in groundwater at the Site. A relatively high concentration groundwater VOC plume was identified in the outwash deposits at the Site extending from southern portions of the Silresim Property, north across the Lowell Iron and Steel property. Over 70 VOCs were identified in the plume, including aliphatics, volatile aromatics, and ketones. Representative contaminants and concentrations included 1,2-dichloroethene, methylene chloride, 1,1,1-trichloroethane, and trichloroethene all reported at maximum concentrations between 1,000 and 2,000 mg/l. Overall, the highest VOC concentrations were observed on and to the immediate north of the Silresim Property. VOCs were also detected throughout the outwash deposits, down to bedrock and at depths of up to 120 feet bgs.

In addition to VOCs, the RI reported some SVOCs in groundwater, generally at concentrations significantly less than those observed for the VOCs. SVOCs that were reported included isophorone, 1,2-dichlorobenzene, benzoic acid, and phenol. SVOC concentrations typically ranged from 0.1 to 40 mg/l and tended to be more localized than VOCs. Metals were sporadically detected in groundwater at various monitoring locations. Among those metals that have been reported are chromium, nickel, and zinc. Maximum concentrations for these metals were generally reported between 1 and 2 mg/l.

### Initial Response

From 1978 to 1982, the Massachusetts Department of Environmental Quality Engineering (MADEQE), now the Massachusetts Department of Environmental Protection (MADEP), secured the Site and minimized immediate threats to public health and the environment. MADEP constructed a site fence, hired a 24-hour guard, removed liquid wastes in the on-site drums and above ground tanks, constructed berms and absorbent filled trenches to reduce the spread of waste through surface runoff, and conducted studies of the site soils and groundwater.

In 1982, EPA placed the Site on the NPL for long term cleanup. Between the Spring of 1983 and December 1984, EPA removed all structures remaining on the Site, extended the fence, and placed a clay cap over the Site. Subsequently, the Site was graded and covered with approximately nine inches of gravel and a clay cap averaging 14 inches in thickness was then placed over the gravel layer. This work was completed in 1984. In addition, crushed stone was placed over the areas of surficial soil contamination adjacent to the cap's northern and southern borders and at the northeast corner of the Site.

EPA expanded the Silresim fence line in August 1986 to enclose an area of surficial soil contamination, encountered during initial phases of the RI, at the southeastern corner of the Site. In December 1986, contractors engaged by EPA placed a 6-inch to 8-inch thick layer of crushed stone around the perimeter of the expanded fence line to limit potential exposure to surficial soils in this zone. The crushed stone area extends 10 to 20 feet east, south and west of the expanded fence line and covers a zone of dioxin contaminated surficial soils encountered during the study.

On July 12, 1985, EPA issued an Administrative Order by Consent to the Silresim Site Trust, a group of Potentially Responsible Parties (PRPs), who agreed to undertake the Remedial Investigation/Feasibility Study (RI/FS) to investigate site conditions and evaluate potential cleanup alternatives that would address contamination at the Site. The Final Draft RI was completed in March 1990. EPA promulgated a ROD for the Silresim Site in September 1991.

## Basis for Taking Action

Contaminants have been detected in different media across the Site for which cleanup goals (CUGs) were derived as part of the 1991 ROD and the ESD completed in September 2003. These compounds have been detected in the noted media (Table 2) at the Site at concentrations that define them as contaminants of concern (COCs). Updated CUGs as a result of the 2003 ESD are included in the tables of Attachment 6.

**Table 2. Silresim Contaminants of Concern**

| Groundwater | Surface Soil | Subsurface Soil |
|---|---|---|
| Vinyl Chloride | 1,1,2,2-Tetrachloroethane | Benzene |
| Acetone | Trichloroethene | Chlorobenzene |
| 1,1-Dichloroethene | 1,2,4-Trimethylbenzene | Chloroform |
| Methylene Chloride | 1,3,5-Trimethylbenzene | 1,2-Dichloroethane |
| 1,2-Dichloroethene (total) | Benzo(a)anthracene | 1,1-Dichloroethene |
| cis-1,2-Dichloroethene | Benzo(a)pyrene | Ethylbenzene |
| Chloroform | Benzo(b)fluoranthene | Methylene Chloride |
| 1,1,1-Trichloroethane | Dibenz(a,h)anthracene | Styrene |
| 1,2-Dichloroethane | Hexachlorobenzene | 1,1,2,2-Tetrachloroethane |
| Benzene | 1,2,4-Trichlorobenzene | Tetrachloroethene |
| Trichloroethene | 2,3,7,8-Tetrachloro-dibenzo-p-dioxin | Toluene |
| 1,1,2-Trichloroethane | PCBs (Aroclors 1242 & 1254) | 1,1,1-Trichloroethene |
| Tetrachloroethene | Arsenic | 1,1,2-Trichloroethane |
| Chlorobenzene | Lead | Trichloroethene |
| Ethylbenzene | Mercury | Vinyl Chloride |
| 1,1,2,2-Tetrachloroethane | | 1,2-Dichlorobenzene |
| Naphthalene | | Hexachlorobenzene |
| 1,2,4-Trichlorobenzene | | Naphthalene |
| Arsenic | | 2,3,7,8-Tetrachloro-dibenzo-p-dioxin |
| Cadmium | | PCBs (Aroclor 1242) |
| Lead | | 1,2,4-Trichlorobezene |
| Nickel | | Lead |
| | | Mercury |

Exposures to surface and subsurface soil and groundwater are associated with significant human health risks, due to exceedances of EPA's risk management criteria for either the average or the reasonable maximum exposure scenarios. Overall risks in groundwater are highest for exposures to the wide variety and high concentrations of volatile organic contaminants present at the Site. Groundwater VOC concentrations significantly exceed relevant risk based screening levels, as well as MADEP standards. Overall risks in soils are also principally due to VOC contamination coupled with localized areas of risks due to metals (primarily lead and arsenic) and to a lesser extent certain semivolatile organics, including dioxin.

## IV. Remedial Actions

### Remedy Selection

On September 19, 1991, the USEPA signed a ROD for the Silresim Superfund Site. The ROD noted that EPA's primary responsibility at Silresim, as at other Superfund Sites, is to undertake remedial actions that are protective of human health and the environment. Therefore, during development of the ROD for Silresim, a number of potential exposure pathways were analyzed for risk and threats to Human Health and the Environment, and summarized in the Remedial Investigation for the Silresim Site (GZA, 1990). As a result of these assessments, remedial action objectives (RAOs) were developed to mitigate existing and future threats to Human Health and the Environment. These RAOs were:

1. Prevent direct contact and incidental ingestion exposure to contaminated surficial soils at the Site (including soils located both on and off the Silresim property);
2. Prevent future migration of contaminated groundwater to a hypothetical water supply well, thereby reducing risks from ingestion of contaminated drinking water;
3. Prevent contaminated groundwater discharge to surface waters, thereby reducing risks from dermal absorption and ingestion exposures to contaminated drinking water; and
4. Prevent contaminated groundwater flow toward buildings, thereby reducing risks from inhalation exposures.

Remedy Components

To adequately address the remedial action objectives for the Silresim Site described above, the ROD adopted a comprehensive remedy consisting of both Source Control and Management of Migration (MOM) components. The remedy components are discussed below.

Source Control

The major components of the Source Control portion of the remedy were identified in the ROD as follows:

1. Post signs at the Site, construct additional perimeter fence and maintain the existing fence;
2. Implement public education programs and institutional controls;
3. Perform a pilot test of a vacuum/vapor extraction system to optimize final design;
4. Construct the vacuum/vapor extraction system;
5. Place low-permeability temporary cover over areas of contaminated soil off the Silresim property;
6. Extend and repair the cap on the Silresim property, as required;

7. Start up and operate the vacuum/vapor extraction system until acceptable VOC concentrations in soil are reached;
8. Perform additional bench-scale and/or pilot scale stabilization/solidification studies;
9. Strip and stockpile the existing clay cap and gravel;
10. Excavate and stockpile all soils requiring stabilization;
11. Backfill areas outside of Silresim property with clean fill;
12. Stabilize contaminated soils;
13. Perform confirmatory Toxicity Characteristic Leaching Procedure (TCLP) analyses;
14. Place treated soil under the Resource Conservation and Recovery Act (RCRA) cap;
15. Upgrade the existing cap to conform to RCRA Subtitle C standards; and
16. Perform long term monitoring and Five-Year Reviews.

As is discussed in the following section, certain Source Control remedy components (e.g., posting signs, implementing public education programs, placement of a low permeability temporary cover, etc.) have been completed. Other source control remedy components such as operation of the soil vapor extraction (SVE) system and construction of a RCRA cap are still being evaluated and/or are still being implemented.

Management of Migration

In addition to the Source Control components, the following MOM components were identified in the ROD:

1. Implement public education programs;
2. Implement institutional restrictions on future water use;
3. Install groundwater extraction wells, pumping equipment, and associated piping;
4. Install treatment equipment, building, and discharge piping;
5. Start up and operate extraction, treatment, and discharge systems;
6. Dispose of non-aqueous phase contaminants and secondary wastes generated during the operation of the treatment process; and
7. Perform long term monitoring and Five-Year Reviews.

The implementation of these components at the Silresim Site is reviewed in the following discussions.

<u>Explanation of Significant Differences (ESD)</u>

An ESD was issued by EPA for the Silresim Site in September 2003. The purpose of this ESD was to establish revised risk-based CUGs for the Site (Attachment 6). A secondary purpose for this ESD was to establish a second OU for the Silresim Site.

At the time the ROD for the Silresim Site was written (September 1991), the groundwater aquifer beneath the Silresim Site was classified by the Federal government as a Class IIB aquifer. The groundwater was identified as a Class I aquifer by the Commonwealth of Massachusetts. Groundwaters assigned to these classes are designated as a potable water supply (potential drinking water). Therefore, in evaluating site risks, the risk assessment developed to support the 1991 ROD assumed that groundwater could be used as a source of drinking water in the site vicinity, and considered this to be a potential exposure pathway.

In October 1998, the MADEP completed a Groundwater Use and Value Determination that recommended a "low use and value" for the groundwater beneath the Silresim Site. As a result, MADEP subsequently reclassified the aquifer as a "Non-Potential Drinking Water Source Area." As a result of this substantive change, the impacts with respect to groundwater exposures and projected risks were re-evaluated. The revised groundwater CUGs resulting from this re-assessment were summarized in a technical report entitled "Final Additional Site Investigation and Revision of Site Cleanup Goals Report," dated January 2002 (Foster Wheeler, 2002).

In addition, to changes in future groundwater use, the CUGs for the Silresim Site were also updated to reflect changes in EPA risk assessment guidance, toxicity values and changes in exposure pathways due to changes in plume contaminant distributions at the Silresim Site that had occurred since September 1991.

## Remedy Implementation

This section describes the implementation of the selected multi-component remedy as specified in the 1991 ROD.

Direct Soils Contact

As specified in the ROD, direct contact and incidental ingestion exposure to contaminated surficial soils at the Site has been prevented through maintenance of a temporary clay cap, site fencing and daily inspections by the on-site operator. These protection measures do appear to be effective, as there have been no reports of any significant compromises to these protection measures.

Management of Migration (MOM)

As stated in the ROD, the selected Management of Migration alternative was MM-2, Groundwater Extraction, Metals Pretreatment, Air Stripping, Aqueous Phase Carbon Adsorption, Vapor Phase Carbon Adsorption or Thermal Oxidation. The GWTP that was placed on line in November 1995 was constructed to meet the requirements of the selected MOM alternative and has been in continuous operation since then.

The GWTP was originally designed to handle 36,000 gallons per day (25 gallons per minute) of contaminated groundwater from the extraction wells. The original system consisted of the following:

- phase separation;
- equalization tank;
- metals removal;
- multi-media filtration;
- preheating of the air stripper liquid feed;
- air stripping;
- liquid granulated activated carbon polishing of the stripper effluent;
- thermal oxidation of stripper off gases; and
- discharge of the treated aqueous stream to the City of Lowell Publicly Owned Treatment Works (POTW).

Note that as part of improvement efforts, the phase separator has never recovered product and has been by-passed, and the liquid phase carbon polishing step was eliminated by increasing the operating temperature of the air stripper.

The GWTP continues to manage the migration of groundwater contaminants through active groundwater extraction from several site wells and on-site physical/chemical treatment to remove the contaminants prior to discharge of the treated groundwater. This operation prevents migration thereby reducing risks from contact by contaminated groundwater, prevents contaminated groundwater discharge to surface waters thereby reducing risks from dermal absorption and ingestion exposures to contaminated surface water and sediments; and prevents contaminated groundwater flow towards buildings thereby reducing risks from inhalation exposures.

The main objective of the GWTP and extraction wells was to contain the groundwater plume (deep extraction wells) and to dewater the Site sufficiently to remediate soils utilizing traditional SVE (shallow extraction wells). Overall, the operation of the GWTP and extraction wells has resulted in VOC contamination concentration reduction in the Silresim plume, although the extent of the VOC reduction varies significantly depending on the specific area of the Site in question. In some site areas, groundwater VOC concentration reductions of over 50% have been observed. However, in other areas of the plume, VOC levels have actually increased due to plume migration and remain over four orders of magnitude above the cleanup levels established in the ROD. Operation of the extraction well array and GWTP has also resulted in the removal of a significant quantity (mass) of VOCs from the groundwater plume.

Source Control

As stated in the ROD, the selected source control alternative was SC-4, Vacuum/Vapor Extraction, Stabilization and Cap on the Silresim Property. The source control remedy involves treating unsaturated zone soils by in situ SVE for removal of VOCs, followed by excavation and stabilization/solidification of unsaturated zone soils exceeding cleanup levels for non-VOCs, followed by on-site containment of treated soils under a RCRA Subtitle C cap.

From July 1995 to December 1996, Air Permeability and SVE pilot tests were completed to fulfill the pilot test requirement of the ROD and to determine the effectiveness of SVE for removing the subsurface contaminants to levels established in the ROD. The Pilot Test included simultaneous operation of the multiple techniques for approximately four months across five areas of the Site. Several significant conclusions and findings resulted from the conditions identified and data gathered from the Air Permeability and SVE Pilot Tests (Foster Wheeler, 1995b; Foster Wheeler, 1997b). During the Pilot Test and associated Air Permeability Test, approximately 4,100 pounds of VOC contaminants were removed.

Following the Pilot Test, a full scale (Phase I) SVE was initiated utilizing information learned from the Pilot Test. Phase I SVE included 14 months of operations beginning in October 1998 and was completed in December 1999, resulting in significant mass removal (estimated 12 tons) of VOCs in the unsaturated zone soils. However, it was determined that SVE without thermal enhancements would not achieve the required soil cleanup goals and was therefore terminated as a source control measure. Limitations to the SVE technology were: 1) low permeability soils; 2) a high groundwater table; 3) high soil moisture contents in the unsaturated zone; and 4) a clay cap with an underlying gravel layer causing short circuiting.

Following an evaluation of SVE thermal enhancement technologies, Electrical Resistance Heating (ERH) was selected for pilot testing. The advantage of ERH technology is that it has been proven effective in the saturated zone. This Pilot Test was designed to evaluate ERH under Silresim Site conditions and determine the effectiveness of ERH for enhancing the performance of soil vapor extraction in the removal of the source of VOC contaminants at the Site. Installation of the ERH system commenced in August 2002. System start-up began in early October 2002. Heating operations were completed over a three-month period ending in early January 2003. One of the major obstacles to SVE was that the shallow groundwater extraction wells were not able to sufficiently dewater the Site as originally intended.

The ERH Pilot Test was located in a site area known to have high levels of VOC contamination in both soil and groundwater. The area of the one array pilot study was approximately 850 $ft^2$. The depth of treatment extended to 40 ft bgs resulting in a total treatment volume of soil and groundwater of

approximately 1,250 $yd^3$. The estimate of mass removed by ERH during the Pilot Test from both soil and groundwater was approximately 1,500 pounds of vapor phase VOCs, with shallow groundwater VOC contamination (to 24 ft bgs) reduced by greater than 99%. Decisions on whether or not to continue with ERH as a source control remedy have not yet been finalized.

To address the excavation of off-property soils containing non-VOC contaminants above cleanup levels, an excavation plan for the affected soils was completed in June 2004, with actual excavations to be completed in the Fall of 2004. The existing plan is to place the excavated off-site soils under the on-site temporary cap, with a permanent cap design to be finalized in 2005.

### System Operations/Operation and Maintenance

The GWTP operational goals include maximizing the influent flow rate while maintaining a VOC influent concentration that is within the design capacity of the treatment system; and meeting POTW discharge permit requirements, the most significant of which is an allowable level of 2.13 ppm total toxic organics (TTO) (sum of detected pesticides/PCBs, semivolatiles, and volatiles), as well as an effluent pH range of between 6 and 9. Acetone has historically been elevated in plant effluent, and based on discussions with the POTW, the current levels of acetone in plant effluent are acceptable because it is easily biodegradable within the POTW.

Long term monitoring and maintenance activities, according to the operation and maintenance (O&M) plan that was approved by EPA, are continuing at the Site. The primary activities associated with O&M include the following:

- Continuous operation of the GWTP, including 24-hr automated operations and two Grade 3 licensed operators on weekdays;
- Monthly discharge monitoring for both groundwater to the Lowell POTW and vapor discharge from the thermal oxidizer stack;
- Semi-annual groundwater sampling and analysis from site groundwater monitoring wells, with one annual event more comprehensive than the other; and
- Visual inspections of the groundwater extraction and monitoring wells, temporary clay cap, drainage swales and site fencing.

Foster Wheeler Environmental Corporation (Foster Wheeler) completed construction of the GWTP in November 1995, and was the O&M Contractor through the end of their contract period in 2002. As of June 2002, Watermark Environmental, Inc. (Watermark), has taken over the management of the GWTP

and all associated operations at the Site and is the current O&M contractor. Watermark is under contract to the USACE for O&M of the GWTP and the Site through May 2007.

The GWTP has been operated as designed, with improvements continually being sought as operational experience is gained. Some of the major recent improvements to the GWTP O&M are listed below:

- Eliminated liquid phase carbon step by increasing the operating temperature of the air stripper to enhance removal of methylene chloride, which also resulted in more aerobic effluent (and also eliminated an odor problem);
- Reduced the operating temperature of the thermal oxidizer from 1,600°F to 1500°F, resulting in a savings in natural gas usage without compromising effectiveness;
- Designed and installed a new Hastelloy heat exchanger for the thermal oxidizer to replace the one that failed within two years of operation. The replacement heat exchanger has been in operation since April 2001 with no evidence of deterioration.
- Installed an automated blending system for polymer in the Metals Removal System, eliminating the need for weekend staff;
- Improved the autodialer system to allow for faster problem recognition and resolution;
- Upgraded the plant capacity from 25 gpm to 35 gpm by upgrading to 2-inch piping;
- Reduced the groundwater monitoring frequency and process monitoring frequency;
- Instituted a semi-annual preventative maintenance program to increase operating efficiency; and
- Performed bench-scale testing of polymers to provide better sludge settling rates, resulting in less solids loading to the filters and less frequenting backwashing of the filters.

Following a comprehensive review and modeling of the Site groundwater extraction strategy, TtFW (d.b.a. Foster Wheeler) implemented an improved MOM strategy in 2001. The new strategy implemented a modified extraction scenario by revising the groundwater extraction network. The revised groundwater extraction network included installing one additional shallow-depth well (EW-28), four new shallow/moderate-depth wells (EW-26, 27, 29 and 30) and one new moderate-depth well (EW-31). The modified pumping scenario includes the original extraction wells, but primarily uses the newly installed wells to target the contaminated groundwater in the upper aquifer and better manage off-site migration. Currently the GWTP is operating at approximately 22 gpm based on required extraction rates for existing MOM strategy.

O&M costs include GWTP facility operations (i.e., labor, capital equipment and utilities), sampling and monitoring efforts, well maintenance, waste handling and disposal, and report completion to local POTW, MADEP and EPA. Complete O&M costs for recent years have been approximately $1.2M/yr.

## V. Progress Since the Last Review

The first Five Year Review for the Silresim Site was prepared by EPA in September 1999 as a Type 1A review for sites at which remediation was ongoing. The first review summarized the remedial action progress that had been made at the Site since the ROD was promulgated in September 1991. The first review also identified outstanding issues that had arisen, in the course of implementing the ROD mandated remedy.

Remedy Limitations and Outstanding Issues

At the time of the first Five-Year Review, the principal components of the MOM Remedial Actions had been completed. The GWTP construction was completed in November 1995 and the plant had been operational for almost four years. At the time of the first review, certain MOM operational concerns were identified, including the following:

1. The 13 shallow groundwater extraction wells that were constructed to lower the water table across the Site were not functioning as efficiently as anticipated during design. Due to adverse site stratigraphic conditions (poor hydraulic conductivities), the wells were pumping at rates which were, on average, only 23%-33% of the original design levels and were not depressing the groundwater table as intended.

2. Monitoring evidence indicated that significant elements of the groundwater VOC plume had migrated beyond the extraction well array. Therefore, MOM objectives of containing the groundwater plume were not being attained.

At the time of the first Review, only limited elements of the Source Control Remedy had been initiated. The ROD mandated SVE program was in a design phase. However, air permeability and SVE pilot tests had been implemented. In addition, drainage improvements were undertaken for the clay cap on the Silresim property and a cap upgrade including the addition of a topsoil layer were completed in the Fall of 1998.

Results of the SVE Pilot Test indicated that neither conventional nor enhanced SVE was likely to attain the soil cleanup levels established in the ROD, within the desired time frames. Site factors identified as

contributing to the limited success of SVE included 1) low permeability soils, 2) a high groundwater table, and 3) high moisture contents in the unsaturated zone.

Finally, the first Five-Year Review emphasized the fact that the groundwater in the Silresim Site area had been reclassified based upon the MADEP October 1998 "Use and Value" determination. Therefore, many of the ROD cleanup levels which were based on future use of the aquifer as a drinking water supply and achieving MCLs were no longer appropriate. It was also noted that the leaching model used in the original risk assessment was overly conservative, particularly given the reclassification of groundwater. Finally, it was also noted that certain other assumptions utilized in the original risk assessment, including certain exposure pathways, toxicity assumptions and groundwater leaching assumptions were no longer appropriate for the Site.

Status of Recommendations and Follow-Up Actions

The overall conclusion of the First Five-Year Review was that the selected remedy for the Silresim Site would not achieve several important objectives of the existing ROD. It was therefore, recommended that the overall remedial objectives for the Site be re-evaluated.

Follow-up Actions

As an outgrowth of the concerns identified in the First Five-Year Review and the recommendations of the Silresim Remedy Review Report, a number of follow-up actions were initiated at the Silresim Site. Key follow-up actions are summarized in the table below.

**Table 3. Issues from First Five-Year Review**

| Issues from Previous Five Year Review and Remedy Review Report | Recommendations | Action Taken | Date of Action |
|---|---|---|---|
| Groundwater Reclassified by MADEP | Revise Those ROD Cleanup Levels Based Upon MCLs | Prepare Updated Site Risk Evaluation Report | Summary Report - January 2002 |
| Certain Risk Assessment Exposure/Toxicity Assumptions No Longer Appropriate | Revise Certain Risk Evaluations to Better Reflect Updated Site Knowledge and Current Risk Guidance | Prepare Updated Site Risk Evaluation Report | Summary Report - January 2002 |
| Groundwater Plume has Substantively Breached the Extraction Well Array | Reevaluate MOM Objectives and Operations | 1] Perform Groundwater Flow Modeling<br>2] Modify Extraction Well Array | 1] Modeling Report - June 2000-Ongoing<br>2] June 2000-Ongoing |
| SVE Incapable of Meeting ROD Cleanup Levels in a Reasonable Time Frame | Consider Alternative Vapor Extraction Technologies | Perform Pilot Test using ERH and Prepare Summary Report | ERH Pilot Test - October 2002 - January 2003<br>Summary Report - September 2003 |

As noted in the above table, recommendations in the First Five Year Review relating to groundwater reclassification were addressed through the performance of a risk assessment review and update (discussed in Section VII). This risk evaluation update also simultaneously addressed certain additional concerns related to exposure and toxicity assumptions used in the original risk assessment which were no longer entirely appropriate for the Silresim Site. The results of this risk evaluation were summarized in a report entitled "Site Investigation and Revision of Site Cleanup Goals Report" prepared by Foster Wheeler under contract to the USACE in January 2002. In the absence of a drinking water exposure pathway, the cleanup levels for certain volatile organics significantly increased, as MCLs no longer needed to be achieved. However, certain other VOC inhalation exposure pathways assumed greater prominence (Attachment 6). In addition, due to revised exposure pathway/toxicity assumptions, the cleanup levels for a few volatile organics actually decreased, as is further discussed in Section VII.

To address concerns related to achievement of ROD MOM objectives, groundwater evaluations and modeling were conducted using two complimentary modeling approaches (Modflow and EVS-PRO) to develop a better understanding of site hydrogeology, including issues related to plume migration beyond the extraction well array and the difficulties encountered in attempting to lower the water table. The results of this multi-faceted modeling effort were summarized in the report entitled "Management of Migration and Source Removal Strategy" prepared by Foster Wheeler under contract to the USACE in June 2000. In conjunction with the technical modeling effort, EPA and the USACE modified groundwater extraction well operations to more strongly focus on better achieving containment of the groundwater plume, to ensure protectiveness. Additional extraction wells were installed using the results of the groundwater modeling effort to guide well location selection and screening depths. In addition, GWTP operations, including pumping rates, were modified to better achieve MOM containment.

Based upon results of the SVE Pilot Test, which were viewed as unsatisfactory in terms of reaching contaminant CUGs (although a significant amount of contaminant mass was removed), a second soil volatile organic removal technology [Electrical Resistance Heating] was examined in pilot test studies in 2002 and 2003. Through its direct application of thermal energy to strongly heat contaminated soils, ERH represents a much more aggressive volatile organic removal technology than SVE. As discussed in Section IV, ERH was found to successfully remove substantial quantities of VOCs from unsaturated and saturated zone soils. However, results still indicated that ERH may not achieve cleanup goals for all volatile organic contaminants of concern in time frames envisioned in the ROD. In addition, significant operational costs and certain technical difficulties associated with applying ERH technology to the Silresim Site also represent potential drawbacks to its application.

One difficulty in evaluating the ERH technology application at the Site relates to the fact that considerable uncertainties exist in the estimates of the time frames required to achieve groundwater cleanup.

To assess this issue, an empirical groundwater flushing evaluation was conducted to assess the potential time frames required to achieve site CUGs with and without the use of ERH technologies. Results of this evaluation (Evaluation of Future Groundwater Flushing, Silresim Site; TtFW, 2004) supported the conclusion that even with the application of ERH, achievement of all Site CUGs for volatiles might still exceed 30-year operational time frames.

## VI. Five-Year Review Process

### Administrative Components

EPA, the lead agency for this Five-Year Review, notified MADEP and the PRPs in early 2004 that the Five-Year Review would be completed. USACE, under contract to EPA issued a scope of work, to TtFW, under TERC JV contract DACW33-03-D-0006, in June 2004 to assist EPA in performing the Five-Year Review. The EPA Remedial Project Manager is Mr. Chet Janowski, the MADEP Project Manager is Ms. Janet Waldron, and the USACE Project Manager is Ms. Laureen Borochaner.

### Community Involvement

In early 2004, EPA announced it was performing the second Five-Year Review of the progress of the Silresim Superfund Site cleanup and encouraged public participation. There is an established Community Group that has been involved in neighborhood activities. Beyond limited attendance at a public meeting in March 2002, there has been relatively little participation or involvement from the local community. EPA has continuously kept the local public aware of site activities through interaction with the Lowell Tanner Street Initiative Committee. A Fact Sheet outlining planned activity at the Site, including off-property excavations, was distributed to the local community in May 2004. All site-related documents are available at the Pollard Memorial Public Library in Lowell, MA. According to library staff, there has been limited request for the documents. Attachment 8 contains a listing of all reports and documents that are included in the public file for the Silresim Superfund Site at the Pollard Memorial Library.

### Document Review

This Five-Year Review has consisted of a review of relevant documents including decision documents and status reports, as listed in the References Section.

### Data Evaluation

This section briefly summarizes some of the more pertinent groundwater, soil, and pilot-test monitoring and sampling results that have been compiled, particularly for data collected since the first Five-Year Review.

Groundwater Monitoring

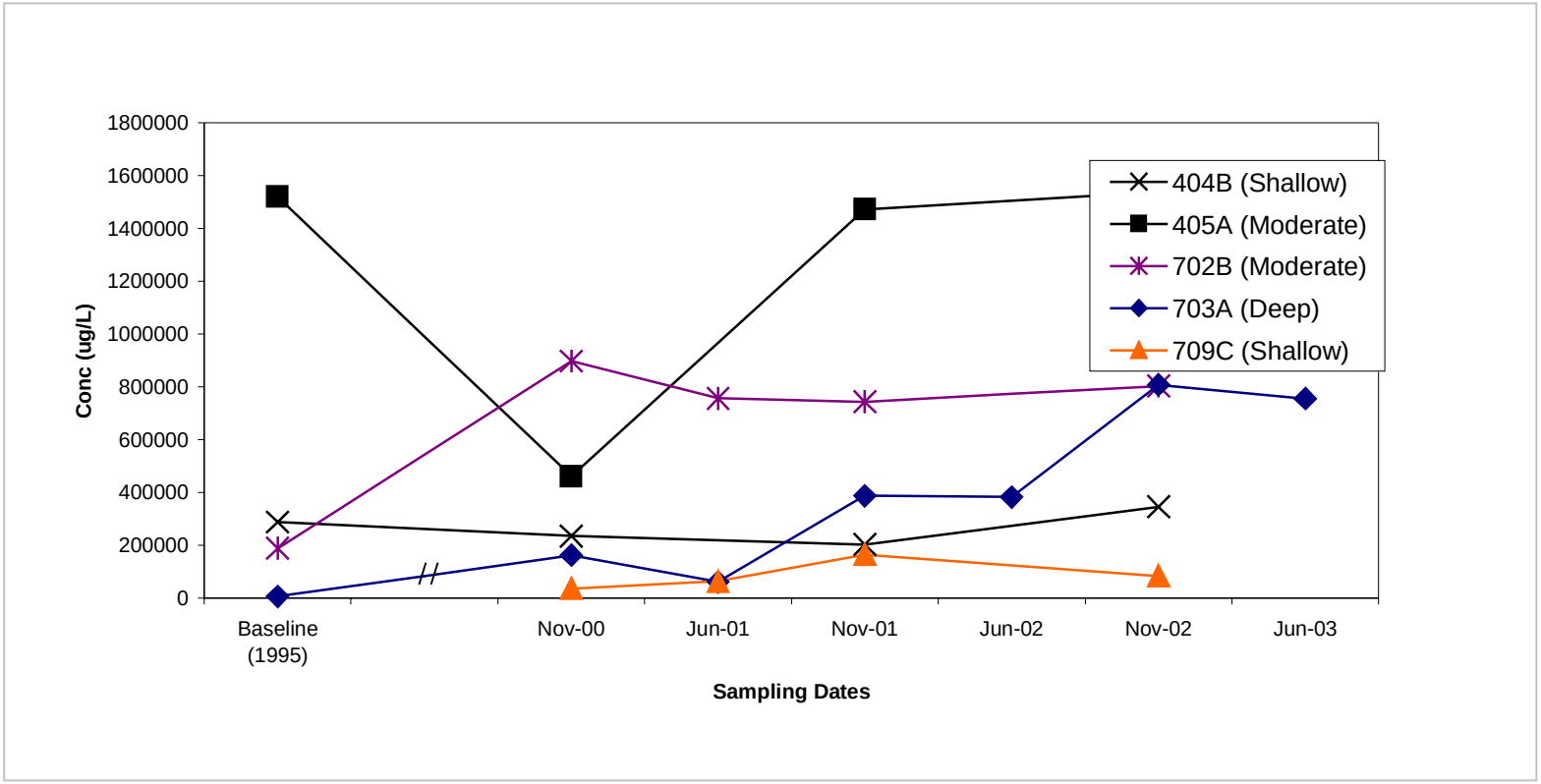
Routine groundwater monitoring has been conducted at the Silresim Superfund Site since a Baseline study was completed in 1995. Groundwater sampling was conducted on a quarterly basis from November 1995 to February 1999. In 1999, the sampling frequency was reduced to a trimester (July 1999 and November 1999), and then to a semi-annual basis beginning in May 2000. The semi-annual sampling is continuing at the Site. As of November 2004, 23 rounds of groundwater sampling have been completed since the Baseline sampling of November 1995.

Groundwater monitoring wells are spread across approximately 40 acres around the area of the Site. Additional wells have been installed (generally downgradient) during several investigation and remedial activities at the Site. Currently there are approximately 90 monitoring wells and 31 extraction wells on the Silresim property and surrounding properties (Attachment 2). Some additional potential sampling points, such as soil vapor extraction wells and multiphase extraction wells are also found on the Site.

Results for sampling conducted at the Site generally have found concentrations of total VOCs greater than 500,000 ug/L for several wells located on parts of the Silresim property, and in the area described as the "source term." Concentrations of total VOCs in groundwater generally decrease to between 10,000 - 100,000 ug/L at locations downgradient of the source term areas across the Lowell Iron and Steel property to the north and towards Tanner Street. It should be noted that some monitoring well locations on the LI&S property do have detections of total VOCs in excess of 500,000 ug/L. Further downgradient between Tanner Street and River Meadow Brook, the groundwater concentrations are < 500 ug/L and finally adjacent to River Meadow Brook, the monitoring well results are < 5 ug/L total VOCs. VOCs detected in groundwater across the Site and downgradient include chlorinated volatiles, aromatics (VOCs), and ketones (acetone).

Groundwater monitoring wells for detailed review were selected based on locations in the core of the contaminant plume (MW-405 and MW-404), in the downgradient area inside the extraction well array (MW-702B and MW-709) and for a location slightly down gradient of the extraction well array (MW-703). The selected wells also span the shallow, moderate and deep layers of the aquifer. Data from November 2000 to June 2003 were reviewed for trends or changes in total VOC concentrations at these well locations (Figure 1). In addition the concentrations for total VOCs were compared to the Baseline groundwater sampling results from 1995.

**Figure 1. Representative Total Volatile Organic Concentration Trends in Groundwater Core Groundwater Plume**



Groundwater sampling at the Site has been performed using bottom loading disposable bailers. This sampling method can potentially result in a low bias in the analytical results for volatiles due to the disturbance of the groundwater and potential loss of analytes during sampling. However, due to the high concentrations of VOCs detected at many of the sampling locations, the low bias is likely not to be significant relative to the levels of contaminants detected. It should be noted that the possible use of passive bag sampling devices for downgradient plume locations is currently under evaluation.

Generally, the results show that for the source area wells selected, the concentration of total VOCs in the groundwater for the most recent sampling event is equal to or greater than the concentration detected in during the Baseline groundwater sampling completed in 1995. Since 2000, the total VOC concentrations in the groundwater at the select wells in the core of the groundwater plume have generally been constant or increasing. The concentrations for total VOCs in the monitoring wells in November 2002, in the area of the core of the groundwater plume (MW-405 and MW-404), are relatively consistent with the results reported in 1995 (Figure 1). Downgradient toward the edge of the extraction well array, the concentrations at MW-702B have increased compared to the Baseline sampling in 1995, and have been consistent from November 2000 to November 2002. The results for total VOCs at MW-709C, which was installed after 1995, have also been relatively constant. Downgradient, immediately past the extraction well array, the results for total VOCs at MW-703A show an increase in concentrations from November 2000 to November 2002 and are significantly higher than detected in 1995.

A review of groundwater data collected in June 2003 for well locations north of the Silresim property show certain individual volatile compounds exceeding the Site CUGs (Table 4). This data also demonstrates the significant variability in groundwater plume concentrations. Since the June sampling is a semi-annual event, the number of wells sampled is generally limited and more focused than during the comprehensive annual round in November. The wells reviewed include one installed as part of the ERH pilot test (MW-716B) and five located to the north and west downgradient of the core of the groundwater plume. The results (Table 4) show that nearer the Silresim property (MW-716B and MW-703A), the number of CUG exceedances increases and include chlorinated VOCs, aromatics and acetone. At locations further downgradient (MW-315A, MW-315B, and MW-711C) the concentrations are significantly lower. However, some concentrations still exceed cleanup goals for 1,1-dichloroethene, benzene, chlorobenzene and ethylbenzene. A comparison of collocated monitoring wells with different screen elevations (MW-703A and MW-703C) shows distinct differences in the groundwater contamination levels. At the MW-703 location the concentrations detected in the deeper well (MW-703A) are found to be significantly higher than those reported in the shallower well (MW-703C).

**Table 4. Representative Groundwater Plume Data June 2003**

| Analyte | CUG (ug/L) | MW-703A | MW-703C | MW-315A | MW-315B | MW-711C | MW-716B |
|---|---|---|---|---|---|---|---|
| **Screen Depth (ft msl)** | | **45.7 – 55.7** | **90.6 – 100.6** | **73.9 – 78.9** | **89.3 – 94.3** | **75.77 – 85.77** | **~ 73 - 83** |
| Vinyl Chloride | 130 | 1200 | 5 U | 73 | 31 | 81 | 10000 U |
| Acetone | 50000 | 360000 | 5 U | 15000 | 190 | 110 J | 10000 UJ |
| 1,1-Dichloroethene | 15 | 830 | 5 U | 5 U | 5 U | 38 | 43000 |
| Methylene Chloride | 14000 | 250000 | 5 U | 1200 | 180 | 5 U | 59000 |
| 1,2-Dichloroethene | 120000 | 72000 | 5 U | 2100 | 250 | 1500 | 3900 J |
| Cis-1,2-Dichloroethene | 50000 | 72000 | 5 U | 2100 | 250 J | 1500 | 3900 J |
| Chloroform | 200 | 5 U | 2 J | 5 U | 5 U | 5 U | 17000 |
| 1,1,1-Trichloroethane | 50000 | 5 U | 2 J | 5 U | 5 U | 5 U | 90000 |
| 1,2-Dichloroethane | 500 | 35000 | 5 U | 96 | 5 U | 46 | 8900 J |
| Benzene | 480 | 10000 | 5 U | 2500 | 320 | 22 | 10000 U |
| Trichloroethene | 1400 | 640 J | 10 | 11 | 11 | 3 J | 340000 |
| 1,1,2-trichloroethane | 1100 | 130 | 5 U | 5 U | 5 U | 5 U | 10000 U |
| Tetrachloroethene | 5000 | 460 | 10 | 12 | 5 U | 4 J | 78000 |
| Chlorobenzene | 500 | 730 | 5 U | 320 | 2200 | 79 | 64000 |
| Ethylbenzene | 3400 | 6200 | 5 U | 1400 | 9100 | 230 | 32000 |
| 1,1,2,2-tetrachloroethane | 610 | 5 U | 5 U | 5 U | 5 U | 5 U | 10000 U |

msl – mean sea level
CUG – cleanup goal
U – non detect at noted reporting limit
J – result is estimated
Shaded data exceed site CUGs.

Groundwater data collected up to June 2003 for wells located to the north of the Site and west of Tanner Street (downgradient of the extraction well array) have not had any significant increases in concentration over the past several sampling events. These wells, beyond the extraction well array, show the stability of contamination plume at a distance from the source areas. This data provides a good indication that the plume is being largely captured and that there is apparently no longer significant source migration from the Site, feeding the plume downgradient. Total VOC concentrations in the groundwater approximately half way from Tanner Street to River Meadow Brook are approximately 200 ug/L while adjacent to the Brook the concentration drop to < 10 ug/L. The data for the wells furthest downgradient have shown no indication of significant increase over the last several years. The data seems to indicate that the operation of the extraction well array does appear to be limiting downgradient plume migration.

Soil Contamination

Soil data collected in 1999 from across the Site along with data collected in 2003 from a more limited area of the Site has also been examined as part of this Five-Year Review. The soil data collected in 1999 was part of a comprehensive sampling program to delineate the VOC source term and to provide data for revising the Site CUGs. The data collected in 2003 was from an area of the Site with significant VOC contamination where a remedial pilot test was conducted. The data reviewed was limited to subsurface soil samples collected from the Silresim and Lowell Iron and Steel properties. Currently the cap on the Silresim property and grading activities on the Lowell Iron and Steel property, limit the usability of surface soil samples to evaluate current site conditions and changes that have occurred. It should be noted that most historic site activities took place on the Silresim property and the most significant VOC contamination source is still located on the Silresim and Lowell Iron and Steel properties.

The results for source term delineation and CUG assessment completed in May 2001 were also reviewed since this is the most recent and complete set of soil data collected at the Site. The data was also used to complete the revision of the Site CUGs. The frequencies of select compounds exceeding the CUGs for subsurface soil at the Site (Table 5), indicate that a variety of VOCs are detected at significant concentrations. Chlorinated ethenes (trichloroethene) and ethanes (tetrachloroethane) along with aromatic VOCs (benzene) were frequently found to exceed the CUGs by several orders of magnitude. Tetrachloroethane had a maximum concentration detected of 5,800 mg/Kg with a CUG established for the Site of 0.85 mg/Kg, benzene had a maximum concentration of 11 mg/Kg with a CUG of 0.04 mg/Kg.

**Table 5. CUG Exceedance Frequency and Maximum Detections for Select Compounds in Subsurface Soils – Silresim and LI&S Properties**

| Analyte | ESD CUG (mg/Kg) | 1999-2000 Silresim and LI&S Sampling CUG Exceedances | | 2002-2003 ERH Sampling CUG Exceedances | | | |
|---|---|---|---|---|---|---|---|
| | | Max Concentration (mg/Kg) | No. of CUG Exceedances | Max Concentration (mg/Kg) | No. of CUG Exceedances Pre-Pilot Test | Max Concentration (mg/Kg) | No. of CUG Exceedances Post-Pilot Test |
| **Chlorinated VOCs** | | | | | | | |
| Vinyl Chloride | 0.0062 | 1.1 | 3/67 | ND | 0/71 | 0.029 | 6/74 |
| 1,1-Dichloroethene | 0.005 | 3.4 | 29/67 | 610 | 34/71 | 2.7 | 57/74 |
| Methylene Chloride | 0.56 | 450 | 25/67 | 320 | 67/71 | 79 | 26/74 |
| Chloroform | 0.015 | 5 | 17/67 | 38 | 57/71 | 8.4 | 26/74 |
| 1,1,1-Trichloroethane | 13 | 1300 | 8/67 | 12000 | 33/71 | 17 | 1/74 |
| 1,2-Dichloroethane | 0.031 | 78 | 30/67 | 42 | 59/71 | 10 | 31/74 |
| Trichloroethene | 0.25 | 1300 | 42/67 | 15000 | 70/71 | 97 | 46/74 |
| 1,1,2-Trichloroethane | 0.12 | 24 | 12/67 | 0.33 | 12/71 | 0.4 | 4/74 |
| Tetrachloroethene | 0.85 | 5800 | 33/67 | 7500 | 64/71 | 110 | 16/74 |
| 1,1,2,2-Tetrachloroethane | 0.16 | 24 | 13/67 | ND | 0/71 | ND | 0/74 |
| | | | | | | | |
| **Aromatic VOCs** | | | | | | | |
| Benzene | 0.04 | 11 | 29/67 | 13 | 25/71 | 4.2 | 27/74 |
| Chlorobenzene | 1.2 | 1000 | 17/67 | 5000 | 41/71 | 29 | 9/74 |
| | | | | | | | |
| Lead | 448 | 4170 | 5/103 | NA | NA | NA | NA |

NA – Not applicable, not analyzed for
CUG – Cleanup Goals

Contamination in the surface soils across the Silresim Site, not including the VOC source term area, is generally sporadic and localized. The contaminants detected in surface soils that exceed CUGs include lead, arsenic, substituted benzenes and PAHs. Most locations with surface soil contamination exceeding the Site CUGs are for a single contaminant, with the most common exceedances being for lead and arsenic. For the subsurface soils the contaminants detected that exceed Site CUGs include lead, mercury, chlorinated benzenes, PAHs, dioxins, and PCBs. The detection of lead is mainly at locations adjacent to the Silresim property and on the LI&S property. The chlorinated benzenes are detected mostly on the Silresim property and near the area of the VOC source term contamination.

ERH Pilot Test Results

The ERH pilot test sampling (2002) results (Table 5) showed that both prior to and after the test, soil samples had detected exceedances for several of the Site contaminants of concern. It is noted that due to the high concentrations of some analytes, the reporting limits for other analytes in samples were often greater than their respective cleanup goals. This, in some cases, led to a situation where the number of samples with CUG exceedances post-test were greater than the number detected pre-test. Vinyl chloride is a good example. Out of 71 samples, no exceedances of the CUG were reported in the pre-test samples, but six samples out of 74 had exceedances of the CUG in the post-test sampling. This is most likely due to the fact that sample reporting limits (post-test) were significantly lower than pre-test and therefore lower concentrations of contaminants that still exceeded the CUGs were detectable after the remediation.

Overall soil VOC concentrations were significantly reduced during the pilot test, though post-test sampling still had VOCs reported significantly above many of the Site CUGs. The maximum concentration for tetrachloroethane was reduced from 7,500 mg/Kg to 110 mg/Kg, however the CUG is 0.85 mg/Kg. Similarly the concentration for chlorobenzene was reduced from 5,000 mg/Kg to 29 mg/Kg which still exceeded the CUG of 1.2 mg/Kg. Trichloroethene, methylene chloride, and 1,1-dichloroethene, due to numerous exceedances of the CUG and/or the low level of the respective CUGs, are found to be significant contributors to the soil contamination both in the comprehensive sampling, the pre-pilot test sampling and the post-pilot test sampling relative to the CUGs for the Site.

In recent soil investigations (2004), lead on the Silresim and LI&S properties (Table 5) was found to exceed the Site CUG in five of 103 samples collected. The maximum concentration detected was 4,170 mg/Kg, which is approximately an order of magnitude above the CUG of 448 mg/Kg. The results of these investigations have been used to support pre-design delineation of off-Silresim property soil excavation areas for non-VOCs. Excavation of these areas is scheduled for completion by Fall 2004.

## Site Inspection

A site inspection was conducted on June 8, 2004 with representatives from EPA, USACE, MADEP, TtFW and Watermark. The inspection included a site walkover, inspection of monitoring and injection wells both within and outside the Site fence, and a walkthrough of the existing GWTP. Site photographs are included as Attachment 4. A Site Inspection Report is included in Attachment 5. The Site is secured by chain-link fencing surrounding the entire Silresim property. The Site wells are secured with locks and protective devices. No incidents of vandalism have occurred, however there were a few cases of monitoring well damage resulting from inadvertent truck and/or equipment contact. The Site is occupied and monitored daily by personnel from Watermark, the current O&M Contractor. A full site inspection is also periodically performed as part of each semi-annual groundwater monitoring event.

The piping and other equipment used during the SVE and ERH pilot tests have been removed. The recent ERH pilot test area, located on the neighboring LI&S property, was restored to former conditions following completion of the Pilot Test in the Spring of 2003. Miscellaneous piping materials, equipment and spare parts (stored in an orderly fashion) were noted behind and inside the building.

The SVE treatment area has been capped with a top soil layer and has been seeded. Additionally, naturally seeded vegetation occurs on surrounding unused areas and the Site appears to be in very good aesthetic condition. As previously described, active remediation for groundwater including containment and treatment is on-going at the Site. Semi-annual groundwater monitoring continues. There are plans for off-property surficial soil excavations, in conformance with the previously identified ROD requirements, in the Fall of 2004.

## Site Interviews

General discussions and observations were documented during the site inspection on June 8, 2004. The list of individuals interviewed regarding this Five-Year Review is included in Attachment 5. The MADEP has responded to one complaint and filed a 21E on the adjacent Lowell Used Auto Parts property. While generally satisfied with site progress to date, MADEP feels some data gaps do remain concerning source removal. Decisions regarding future use of the Site and the need for permanent controls and/or restrictions are ongoing. The public is generally well informed about the cleanup activities, primarily via the Community Group, the Tanner Street Initiative, and periodic distribution of Fact Sheets.

The administrative record and site documents are available at the Pollard Memorial Public Library in Lowell. Few individuals have accessed the documents. The on-site project manager for Watermark, Mr. John Haley, commented that they do not encounter much community concern about the Site.

## VII. Technical Assessment

This section considers the overall functioning of the remedy at the Silresim Site and discusses potential changes in exposure assumptions and remedial action objectives.

Question A – Is the remedy functioning as intended by the decision documents?

The review of documents, ARARs, risk assumptions and the results of the site inspection indicates that, overall, those remedy components for the Silresim Site, that have been completed, are functioning as intended by the ROD, as modified by the ESD. However, as is discussed in Section VIII, the remedy is anticipated to require much longer than 30 years to achieve the Site CUGs.

Groundwater

The groundwater treatment plant continues to operate effectively. The plant continues to remove significant amounts of VOC mass from the groundwater plume. Modifications to the operation of the extraction well array, implemented over the last two years, have significantly increased the effectiveness of containment of the groundwater VOC plume. The groundwater plume now appears to be largely contained. In addition, in many monitoring wells downgradient of the extraction well array, total VOC concentrations appear to have stabilized and in some cases appear to be declining below CUGs, based on recent annual monitoring program data.

There is some concern that substantive elements of the plume that have migrated beyond the extraction well array, may ultimately migrate to River Meadow Brook which is northwest of the Site. However, monitoring results to date have not indicated any substantive VOC migration into River Meadow Brook. Currently, it is not anticipated that plume VOC elements will significantly impact the Brook. Nonetheless, groundwater in this portion of the Site continues to be carefully monitored.

Within the Site source areas encompassed by the extraction well array, groundwater remains highly contaminated. Groundwater concentration trends vary significantly depending upon the specific wells in question. As discussed in Section VI, some wells have shown VOC concentration declines over time while others have not. Total VOC concentrations in a number of wells remain near (and in a few cases well in excess of) 500,000 ug/L. This occurrence reflects the large mass of VOCs still present in unsaturated and saturated zone soils in the source area, even after approximately 9 years of treatment plant operation. As previously noted, concentrations in some wells remain in excess of those levels reported in the 1995 Baseline sampling round.

The results of an empirical groundwater flushing evaluation (TtFW, 2004) indicated that in the absence of any additional source term treatment (other than ongoing groundwater extraction), achievement of ESD mandated groundwater cleanup goals for all VOCs, by groundwater extraction alone, is anticipated to require much longer than 30 years (TtFW, 2004). The lengthy time for remediation was attributed to a combination of the very high levels of residual source term VOC contamination, adverse site stratigraphic conditions, and the low groundwater cleanup levels for certain VOCs.

Soil Capping

Operation of the temporary cap and associated drainage system has largely been effective. Protectiveness has been maintained. The cap upgrade and associated drainage improvements completed in 1998 have been beneficial. Some relatively minor cap maintenance related to the effects of weather and site use continues.

In Summer/Fall 2004, contaminated off-site soils will be excavated and brought onto the Silresim Property. At that time, the temporary cap will be briefly removed to allow placement of the contaminated soil. The cap will subsequently be restored, including installation of an HDPE liner over the newly placed soils as part of the temporary cap to further enhance protectiveness.

Source Control

The results of pilot tests of one vapor phase VOC removal process (ERH), conducted in 2002-2003, showed some success as a potential technology to achieve source control remediation. ERH removed significant amounts of VOC mass from both unsaturated and saturated zone soils. ERH was also significantly more successful in removing VOC contaminated soils than SVE. From an operational perspective, some problems were encountered, particularly during cold weather operation. In addition, evaluations indicated that ramp up and operation of the technology for full-scale application at Silresim would be relatively costly.

Based upon the Pilot Test results themselves and the results of the groundwater flushing evaluation previously noted, it appears that even with the application of ERH, ESD mandated cleanup levels may not be achieved within ROD anticipated time frames. Groundwater flushing calculations suggested that even after ERH application, the GWTP might have to continue operation for a protracted period of time. This conclusion reflects uncertainties in the maximum efficiencies that might be achieved by ERH at the Silresim Site and also by the very low cleanup goals established by the ESD for certain VOCs.

Institutional Controls

The institutional controls that are currently in place on the Silresim Site further support the protectiveness of the Site remedy. As noted, institutional restrictions on groundwater use are in place. The perimeter

fence around the Silresim Property continues to be maintained with appropriate signs posted. Public education and informational programs continue to be implemented to ensure that neighborhood residents and municipal officials are aware of ongoing activities at the Site.

There have been no significant problems related to observance of these institutional controls although occasional trespassers continue to traverse the Site perimeter fence. Since the Site soils are covered by a temporary cap, this has not been a substantive concern.

System Operations/O&M

As previously indicated, groundwater is treated by a pump-and-treat system consisting of groundwater extraction, above-ground treatment, and discharge to the City of Lowell Regional Wastewater Utility. The groundwater treatment plant began operations in 1995. Substantial modifications to the groundwater extraction operations, including the addition of new wells, occurred in early 2001.

The system originally consisted of 25 extraction wells (EW), each separately piped to the treatment plant. The original 25 extraction wells were screened in different vertical zones (13 shallow aquifer, 2 moderate overburden, 9 deeper overburden, and 1 bedrock). Each well was designed to pump at approximately 1.0 gpm. Historically, average production from each of the shallow wells was approximately 0.3 gpm, while average production from each of the moderate and deep wells was approximately 1.5 gpm.

The first Five-Year Review conducted in 1999 noted that, with respect to the original extraction strategy, "there has been extensive plume migration beyond the extraction well array." In addition, concerns were raised that some of the deeper extraction wells might be drawing contaminants downward from the shallow zone. Therefore, a new pumping strategy was implemented in early 2001. This strategy appears to be much more effective than the previous extraction scenario. However, it is still not clear that the current system completely captures all groundwater that exceeds current cleanup goals. Presently a recommendation has also been made to make additional changes to enhance source removal. These modifications have not yet been implemented and therefore cannot be assessed at this time.

As previously discussed, six new wells were placed into service on February 2, 2001, and the overall pumping strategy was revised in an attempt to limit the downward migration of contaminants by focusing extraction in the shallow aquifer. There are six new wells (numbers EW-26 – EW-31), and these wells were to operate with 10 of the original wells (numbers EW-2 – EW-8 and EW-11– EW-13) for a total of 16 operating wells. All of the wells currently operating are shallow wells, with the exception of EW-17 and EW-31, which is located north of the property and is screened down to bedrock. The purpose of EW-31 is to intercept both deep and shallow groundwater contamination that may have migrated beyond the operating shallow extraction wells. EW-17 is intended to augment the capture zone for deeper

groundwater, and is also located beyond the extent of the shallow wells. The new shallow wells are screened somewhat deeper than the older shallow wells, to increase the potential for greater groundwater extraction rates.

Following the modified extraction well scenario, the O&M Contractor has been placing more emphasis on the overall stature and migration of the contaminated plume. Some of the enhancements have been to install remote data-logging transducers into area monitoring wells to continuously record well levels; seasonal operating ranges (i.e., evaluating impacts of precipitation) have been identified and modified as necessary to optimize extraction; and the Site groundwater model with particle tracking has been updated to confirm achievement of desired operational strategy. Additionally, several modifications have recently been made to the extraction well system and hydrogeological analyses. These include inserting packers into selected extraction wells to effectively reduce and raise the screened intervals (EW-19, 20, and 21) and to interpret the hydraulic head distributions of the system in three dimensions. These adjustments have been made to more effectively enhance the hydraulic capture zones and also enhance the way the collected data is interpreted.

Cost of System Operations/O&M

Task Budget for Current Year:

| | |
|---|---|
| GWTP Operations | $428K |
| Utilities & Supplies | $211K |
| Sampling & Analysis | $189K |
| Waste Handling & Disposal | $ 32K |
| Project Management | $240K |
| Upgrades/Improvements | $ 90K |
| Total | $1.2M |

Labor

The plant is currently operated by two people 10 hours per day, 5 days per week, at a cost of approximately $160,000 per year. Additionally, there is a technician with rotating responsibilities (operation, sampling, etc.) and a full-time administrator in the trailer. There are also labor costs associated with project management, monitor well sampling, reporting, semi-annual shutdowns and associated maintenance, information management, monthly meetings, and other project support. These additional labor requirements total nearly $600,000 per year.

Laboratory Analysis

Laboratory support for process monitoring accounts for approximately $50,000 per year. Laboratory costs for groundwater monitoring, air sampling, and waste disposal sampling are approximately $60,000 per year.

Security, Snow Removal, Groundskeeping

Security was an approximate cost of $7,000 per month, but that was eliminated based on previous recommendations that 24-hour security was no longer required. Snow removal and grounds keeping are approximately $20,000 per year.

Utilities

Natural gas is the largest utilities cost, at approximately $80,000 per year. This is primarily related to operation of the thermal oxidizer and preheating the air stripper feed water. Natural gas is also used to heat the building to 62 °F in winter. Electricity costs are approximately $25,000 per year (pumps, air stripper, lighting, etc.). Telephone, water, and sewer are approximately $20,000 per year.

Non Utility Consumables

Chemicals used in the treatment process account for approximately $20,000 per year. Parts, tools, lab equipment, and health and safety equipment cost approximately $73,000 per year. Office supplies cost approximately $2,000 per year.

Disposal Costs

The largest disposal costs are associated with disposal of sludge from the Metals Removal System (MRS), and disposal of PPE, which combined cost approximately $30,000 per year.

Opportunities for Optimization

A reduction in the groundwater monitoring well network should be considered based on a review of results from the prior events. The number of upgradient, wells should be evaluated over the next year for possible elimination from future monitoring events. Decisions on primary function of GWTP should be more clearly defined in order to optimize operation, i.e., should primary focus be on migration of management or source control? Additional source control technologies, although not expected to result in achieving all cleanup goals, may be useful in reducing projected GWTP operation durations. Also, gathering natural attenuation parameters may be useful in possibly achieving a desired remedy of monitored natural attenuation and biodegradation for downstream areas of the Site.

Implementation of Institutional Controls

The institutional controls that are in place include prohibitions on the use or disturbance of groundwater until the cleanup levels are achieved. Institutional controls limiting the excavation of contaminated soils and other actions that might interfere with the selected remedy, are also in place. The Silresim Property itself is surrounded by a six-foot fence and gated. The fence is intact and in good repair. The temporary

cap and surrounding areas are undisturbed and no new uses of groundwater were observed during the site inspection. No activities were observed that would have violated the institutional controls. Currently, institutional controls relating to the activities of utility workers that may operate on-site are being reviewed to assess long term appropriateness.

Question B – Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?

Following the Five-Year Review of the site activities in September 1999, a comprehensive effort was undertaken to address the issues identified that related to the continued potential for public exposure to site contaminants and ensure the continued protection of the public and the environment. This effort resulted in a complete revision of site cleanup goals in January 2002 (FWENC, 2002). The objectives of this comprehensive effort were:

- Review of the Site groundwater reclassification at the Site that eliminated the need to clean up the groundwater to allow its use for drinking water;
- Evaluation of the recently collected sampling results and the current site conditions;
- Identification of the remaining or the newly identified exposure pathways (and updating and revising, as necessary, the conceptual site model) and development of response objectives to coincide with the remaining or newly identified exposure pathways;
- Evaluation of appropriateness of the groundwater leaching model and subsequent development or application of new soil-to-groundwater modeling parameters or data, as necessary; and
- Development of revised CUGs for all impacted site media (principally groundwater and unsaturated zone soils) consistent with the updated conceptual site model and the applicable site RAOs.

Using the data collected during the Additional Site Investigation and selected previously collected data, the detected chemicals were screened to develop a revised site list of chemicals of potential concern (COPCs) for the Site soils and groundwater. This list of COPCs included more chemicals than were addressed in the existing ROD. The revised COPC list, an updated conceptual site model, and updated toxicity values were used to calculate risk-based Benchmark Assessment Values (BAVs) in accordance with the current risk assessment guidance and protocols. Specified target risk goals for projected incremental lifetime cancer risk and the non-carcinogenic Hazard Index were considered. Chemical-specific risk-based BAVs were calculated for each combination of impacted environmental medium and identified site receptor potentially exposed to that medium. The most stringent risk-based BAV for each

chemical and environmental medium was identified to ensure that all receptors would be protected. Risk-based BAVs were calculated for all chemicals detected at the Site that were not be screened out as posing insignificant risk potential based on the USEPA Region I COPC screening procedure. The BAVs were compared to the Site data collected for each property. Only those COPCs that were detected at concentrations above the BAV were retained as proposed CUGs, as it was this subset of chemicals that had the potential to contribute most significantly to overall site risk. An alternate target carcinogenic risk level within the USEPA's acceptable risk range was then evaluated and adopted.

The new CUGs did not show an overall increasing or decreasing trend, as compared to the corresponding chemical-specific target cleanup levels in the existing ROD. Although groundwater was no longer considered a potential source for drinking water, evaluation of other exposure pathways not previously considered (such as the indoor air inhalation of volatile organic compounds) resulted in the CUGs being equally or more stringent than the existing ROD cleanup levels, for some chemicals. The new CUGs were less stringent than the existing ROD levels for other chemicals.

These CUGs were incorporated into the ESD document for Operable Unit 1 (USEPA, 2003), and constitute the operative baseline against which this review was performed.

Standards and To Be Considered Requirements

The consideration of a number of the chemical specific Applicable or Relevant and Appropriate Requirements (ARARs) and TBCs was an explicit part of the process for identifying revised CUGs described above. The MADEP Massachusetts Contingency Plan (MCP) was considered an ARAR relative to the specification of the CUGs (especially the Upper Concentration Limits (UCLs) and the Method 1 GW-3 Standards). CUGs for dioxin and lead also were established based on prevailing USEPA policy.

The MADEP MCP will undergo further revisions sometime in the 2004 or 2005 timeframe. These "Wave 2" revisions were originally proposed in December 2001 and have evolved considerably as evidenced by an on-line presentation of the proposed changes posted in December 2003 (MADEP, 2003). These revisions will likely include changes to the chemical specific numerical standards and will:

- update toxicity values;
- add new chemicals;
- revise the groundwater standards;
- revise the soil standards; and
- update the Reportable Concentrations (RCs) and the UCLs.

Given the comprehensive site-specific reassessment of these same factors for the recent development of the new CUGs, the direct impact of the Wave 2 revisions is not expected to be great. Changes to the MCP dilution/attenuation factors relative to the GW-3 Standards, and the potential subsequent impact on the UCLs may be an exception. The more in depth consideration of indoor air migration likely to be reflected in the revised Method 1 GW-2 Groundwater Standards was addressed in a site-specific manner in the CUG development and is reflected in the CUG values incorporated into the ESD.

Bases for Cleanup Goals

The basis for each individual CUG incorporated in the ESD (i.e., for each chemical in each relevant environmental medium) was documented in the CUG tables presented in the ESD (Attachment 6). The vast majority of the CUGs for surface and subsurface soil were developed from risk-based calculations, with the CUG values for only three chemicals being set to the MADEP MCP UCL for that chemical in soil. The majority of the CUGs for groundwater also were developed from risk-based calculations, with a few values being set to the respective MADEP MCP GW-3 Standard for that chemical in groundwater. No significant justification for additional changes to these bases has been identified since the recent ESD.

Changes in Expected Land Use

There has been no change in expected land use or zoning at the Site since the ESD. It should be noted that the possibility that a portion of the Site could be reused as a soccer field or similar recreational facility was considered by USEPA and MADEP in the development of the CUGs (Foster Wheeler, 2001). A child recreational receptor was assessed in anticipation of this potential change. However, this change in land use has not occurred and is not reflected in the CUGs.

New Routes of Exposure or New Receptors

No new routes of exposure have been identified since the ESD. It should be noted that a potential indoor vapor migration exposure pathway was incorporated into the CUGs reflected in the ESD. Also, since the promulgation of the ESD, there has been renewed interest in the short duration potential exposure of a utility worker to site contaminants in an open excavation. An effort was recently completed to characterize and calculate the projected short-term risk to this potential receptor assuming exposure to contaminated site groundwater and soil during utility repair or replacement activities on one of the Site properties. This effort is not being conducted to potentially alter the CUGs presented in the ESD, but rather to generate information relevant to identifying possible institutional controls or restrictions that may be required to protect a utility worker while he or she is in one of the impacted areas. It appears that such controls or restrictions may not be necessary.

Newly Identified Contaminants

Continued groundwater monitoring and selected supplemental soil sampling has taken place at the Site since the Additional Site Investigation performed in support of the ESD. However, no new chemicals have been detected that were not considered in the CUG development and COPC screening process, and no significantly higher concentrations of the previously identified contaminants have been observed. No new indoor air monitoring has taken place since the ESD at the Operations Building and the Administration Building on the Lowell Iron and Steel Property. Consequently, there have been no newly identified contaminants or contaminant sources since the ESD.

Unanticipated Toxic Byproducts of the Remedy

The only non-investigative element of the remedy that has been implemented at the Site since first Five-Year Review has been the ERH Pilot Test in 2002/2003. This process was not anticipated nor was it observed to generate or release any toxic byproducts that may have impacted the public. Initial concerns with electrical charge dissipation in the soil nearest the test module were addressed with no impact to the public.

Changes in Site Conditions

There have been no significant changes in site conditions since the exposure and risk assessment supporting the ESD.

Changes in Toxicity Values or Other Contaminant Characteristics

Updated toxicity values and associated factors were used in the development of the CUGs in 2002 and were incorporated into the ESD. A few changes to the toxicity values listed in the Integrated Risk Information System (IRIS) database have occurred since that time. These were:

- Trichloroethene (Potentially impacting surface and subsurface soil and groundwater)
- Benzene (Potentially impacting subsurface soil and groundwater)
- 1,1-Dichloroethene (Potentially impacting subsurface soil and groundwater)
- Acetone (Potentially impacting groundwater)

The carcinogenic assessment for trichloroethene (TCE) was withdrawn from IRIS at the time of the CUG assessment. The toxicity values (oral and inhalation, carcinogenic and non-carcinogenic effects) that were withdrawn but were previously listed in IRIS were used to develop the risk-based CUGs. Since that time, the National Center for Environmental Assessment (NCEA) proposed new toxicity values for TCE for the various routes of exposure and health effect endpoints (NCEA, 2001). The proposed NCEA Cancer Slope Factors (CSFs) for inhalation and oral exposures both reflect that TCE is more potent as a carcinogen than was previously indicated by the withdrawn IRIS values. The proposed NCEA Reference Dose (RfD) for oral exposure reflects that TCE is more potent as a non-carcinogen than was previously

indicated by the withdrawn IRIS values, but that it is slightly less potent as a non-carcinogen via inhalation exposure (Wong-Yim, 2003). These toxicity values are still just proposed and are undergoing further review and debate. Should these values ultimately become accepted by USEPA Region 1 and MADEP, the risk-based BAVs for TCE would be an order of magnitude lower than were calculated for the development of the current CUGs for soil and groundwater.

A non-carcinogenic RfD and a Reference Concentration (RfC) were added to IRIS for benzene on April 17, 2003 (after the CUG development effort). No non-carcinogenic RfD or RfC were used in the CUG development process. The current CSFs for benzene were used in the CUG development process. Given the relative potency of benzene in causing cancer, it is not likely that the BAVs or CUGs for benzene calculated relative to non-carcinogenic effects would be more stringent than those that were calculated relative to carcinogenic effects.

A revised non-carcinogenic RfD and a RfC were published in IRIS for 1,1-dichloroethene on August 3, 2002 (after the CUG development effort). The revised RfD reflects a non-cancer health effect inducing potency via the oral exposure route that was two times as great as what was assumed in the CUG development effort. The revised RfC reflects a non-cancer health effect inducing potency via the inhalation exposure route that is two and a half times as great as what was assumed in the CUG development effort. Changes in the CUG for this chemical by this relatively small amount would not be expected to shift an overall projected risk for a receptor from within the USEPA acceptable risk range to a level that exceeded it. Verifying this would require a location-specific evaluation of the particular mix of chemicals present in the area of interest.

There were changes made to the toxicity values listed in IRIS for acetone. However, the groundwater CUG for acetone was established using the MADEP MCP GW-3 Standard that would not be affected by these human health-related toxicity value changes.

Changes in Risk Assessment Methods

There has been new draft guidance published by USEPA and MADEP on the evaluation of the vapor intrusion to indoor air exposure pathway since the ESD (USEPA, 2002; MADEP, 2002). This guidance has raised the level of awareness about, and focus on, this potential pathway considerably. The potential contributions to risk from this exposure pathway were explicitly included in the development of the CUGs for the volatile compounds that are incorporated into the ESD in the site-specific manner described in the draft guidance. Therefore, this new risk assessment method would have no impact on the CUGs.

Question C – Has any other information come to light that could call into question the protectiveness of the remedy?

There have been no significant changes in site ARARs (Attachment 6) since the first Five-Year Review, other than those exceptions previously discussed in Question B.

There is no additional information that calls into question the protectiveness of the remedy at this time. At the present time there is no evidence that the downgradient migration of the plume has adversely impacted ecological and environmental protectiveness as they pertain to River Meadow Brook or East Pond. Groundwater monitoring proximate to these two environmental receptors continues. Current air and vapor monitoring does not indicate any vapor inhalation issues associated with site buildings.

From the human health perspective, future land use for the properties encompassed by the Site will have to continue to be closely monitored. As previously noted, the Silresim Site is defined, in large measure, by the footprint of the groundwater plume and encompasses pieces of several adjacent properties. Most of the properties surrounding the Site are currently in commercial or industrial use. However, should the City of Lowell propose alternate residential or recreational uses for any portions of the Site, risk exposure assumptions would have to be revisited, at that time, to ensure that protectiveness is maintained. This might require the implementation of additional institutional controls.

Technical Assessment Summary

According to the data reviewed, and the Site inspection, the remedy components that have been completed to date are functioning as intended by the ROD, as modified by the ESD. There have been no changes in the physical conditions of the Site that would affect the protectiveness of the remedy.

The principal overall issue that could affect the future protectiveness of the remedy is the fact that based upon available information, the cleanup goals established by the ROD as modified by the ESD, are anticipated to require much longer than 30 years to achieve. As such, the remedial technologies proposed by the ROD (groundwater extraction and SVE) are not anticipated to achieve CUGs in the foreseeable future. Therefore, it is currently anticipated that the GWTP will need to continue operation indefinitely (much longer than 30 years), in order to maintain containment of the core of the groundwater plume. Premature cessation of groundwater extraction operations would allow downgradient migration of the core of the plume to resume, potentially jeopardizing site protectiveness. In addition, given the size (mass) of the residual VOC subsoil and groundwater source term, institutional controls will need to continue to be enforced for the foreseeable future, throughout source term areas.

## VIII. Issues

The following table (Table 6) summarizes some of the more substantive issues that might impact overall remedy protectiveness either currently or in the future. It should, however, be emphasized that the overall remedy is currently considered to be protective of human health and the environment.

**Table 6. Outstanding Issues**

| Issue | Currently Affects Protectiveness | Affects Future Protectiveness |
|---|---|---|
| The Remedy (and its Remedial Technologies) Will Not Achieve Cleanup Goals in Time Frames Anticipated by the ROD | No – GWTP Plume Containment and Institutional Controls are in Place to Ensure Protectiveness | No – However, GWTP Operation and Institutional Controls will be Required Until Cleanup Goals are Achieved |
| Elements of the Plume Have Migrated Past the Extraction Well Array | No – Downgradient Monitoring Does Not Indicate a Current Adverse Impact to Human or Environmental Receptors | Possibly – Might Affect Future Environmental Protectiveness at River Meadow Brook; Continued Monitoring Appropriate |
| Elements of the Core of the VOC Plume on Silresim and LI&S Properties Remain Highly Contaminated | No – Institutional Controls in Place to Provide Human Health Protectiveness | No – As Long as GWTP Operation, Institutional Controls and Monitoring Continue Until Cleanup Goals are Achieved |
| Groundwater Plume VOC Vapor Intrusion into Buildings | No – Monitoring Does Not Indicate Current Problems | Possibly – Long Term Air Monitoring Program Warranted; Remedial Actions May Need to be Implemented |
| NCEA may propose new toxicity values for TCE | No Immediate Impact | Yes – Potentially Significant Adverse Impact (i.e., New CUGs may be Necessary and Increased Time Frames to Achieve It) |

As indicated above, the ROD mandated remedy remains protective of human health and the environment. However, the Site, including the core of the groundwater plume, remains highly contaminated. It is also anticipated that the achievement of ESD cleanup goals may require time frames much longer than 30 years. Therefore, to ensure future protectiveness both continued operation of the GWTP and continued implementation of institutional controls will likely be required indefinitely.

Also, as noted, the proposed NCEA toxicity values for TCE may become generally accepted which could translate into a reduction in the risk-based BAVs for Silresim by an order of magnitude. This would indirectly impact future protectiveness. In addition, flushing calculations suggest that achievement of CUGs for TCE is likely to be one of the principal factors determining the length of groundwater remediation and GWTP operation at Silresim. Therefore, a substantive reduction in the CUG for TCE could significantly lengthen the estimated time required for long term operation of the GWTP.

## IX. Recommendations and Follow-up Actions

This section summarizes recommendations and associated follow-up actions for the Silresim Site. These recommendations (Table 7) are in large part based upon the issues identified in Section VIII. In addition, certain recommendations that do not directly affect remedy protectiveness, but do impact ongoing remedy implementation, have also been included.

**Table 7. Recommendations and Follow-Up Actions**

| Issue | Recommendations and Follow-Up Actions | Party Responsible | Schedule | Protectiveness |
|---|---|---|---|---|
| The Remedy Will Not Achieve Cleanup Goals in Time Frames Anticipated by the ROD | Continue to Optimize GWTP Operation | USACE | Ongoing – Should be Continued | Affects Time to Achieve CUGs – Although ROD Clean Up Times will still be Significantly Exceeded |
| Groundwater Plume VOC Vapor Intrusion into Buildings | Develop Well Defined Vapor Intrusion Monitoring Program Consistent with Recent EPA and MADEP Guidance | EPA/USACE | Scheduled for Near Term Development | Ensures Future Protectiveness |
| Elements of the Core of the VOC Plume on Silresim and LI&S Properties Remain Highly Contaminated | Review Adequacy of Institutional Controls for Long Term Site Operation | EPA/USACE | Under Review | Ensures Future Protectiveness |
| Very Limited Data to Support Remedial Alternatives Evaluation for Non-Contained Plume Elements | Develop Plan to Collect Data to Assess Natural Attenuation | USACE | Under Review | Currently, not an Issue |
| Future Site Protectiveness Relies Significantly on Institutional Controls | Review Overall Adequacy of Institutional Controls Site-Wide | USACE/EPA | Under Review | Ensures Future Protectiveness |
| The Remedy Will Not Achieve Cleanup Goals in Time Frames Anticipated by the ROD | Consider Some Source Control VOC Remediation | USACE/EPA | Under Review | Affects Time to Achieve CUGs – Although Protracted Cleanup Times May Still be Required |
| Downgradient Plume Shape Adjacent to Meadow Brook – Not Completely Defined | Consider an Additional Monitoring Well(s) | USACE/EPA | Under Review | Would Reduce Uncertainty Regarding Protectiveness |

As indicated above, the principal concern related to the Silresim Site relates to the fact that the remedy is currently not anticipated to achieve CUGs in time frame anticipated by the ROD. Therefore, prolonged operation of the treatment plant (much longer than 30 years) is currently anticipated. Optimization of the GWTP operation is warranted to support long term operations although this activity alone is not anticipated to fundamentally alter the time frames required to achieve CUGs.

In addition, since portions of the Site (groundwater and subsurface soils) remain highly contaminated, institutional controls and environmental monitoring will also need to continue to be implemented for a

prolonged period of time. The multiple properties and associated businesses within the Site somewhat complicate the implementation of institutional controls. It, therefore, appears appropriate to continue detailed review of existing institutional controls and possible updating, if necessary, to ensure long term protectiveness.

## X. Protectiveness Statements

The remedy is expected to be protective of human health and the environment upon attainment of groundwater cleanup goals, through long term operation of the groundwater treatment plant (OU 1). The exact time required to achieve CUGs is uncertain but is currently anticipated to be much longer than 30 years. In the interim, exposure pathways that could result in unacceptable risks are being controlled and institutional controls are preventing the exposure to or the ingestion of contaminated groundwater.

All additional threats at the Site are currently being addressed in the Source Control Remedy (OU 2) through the ongoing excavation and capping of contaminated surface and subsurface soils, the installation of fencing and warning signs and the implementation of institutional controls. Air and vapor monitoring programs are also being implemented to ensure protectiveness with respect to inhalation.

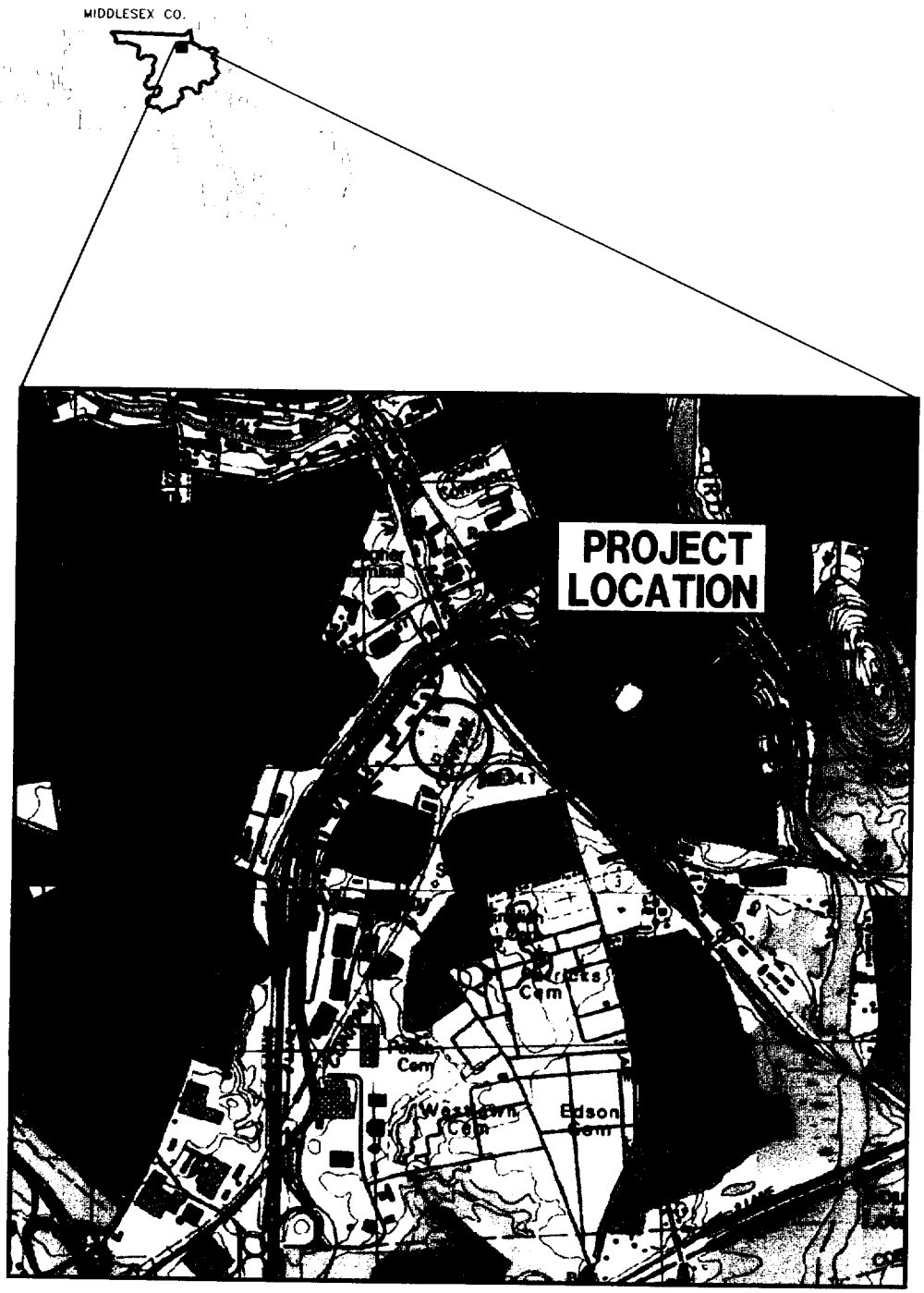
Long term protectiveness of the remedial action will continue to be verified through ongoing groundwater, surface water, and air monitoring programs. These monitoring programs will address downgradient components of the plume that have previously migrated past the extraction well array. Current monitoring data indicates that the plume now appears to be largely contained.

## XI. Next Review

The next Five-Year Review for the Silresim Superfund Site is required by September 2009, five years from the date of this review.

# ATTACHMENTS

# ATTACHMENT 1
# Site Location Map




0 2000 4000

SCALE IN FEET

**ATTACHMENT 1**

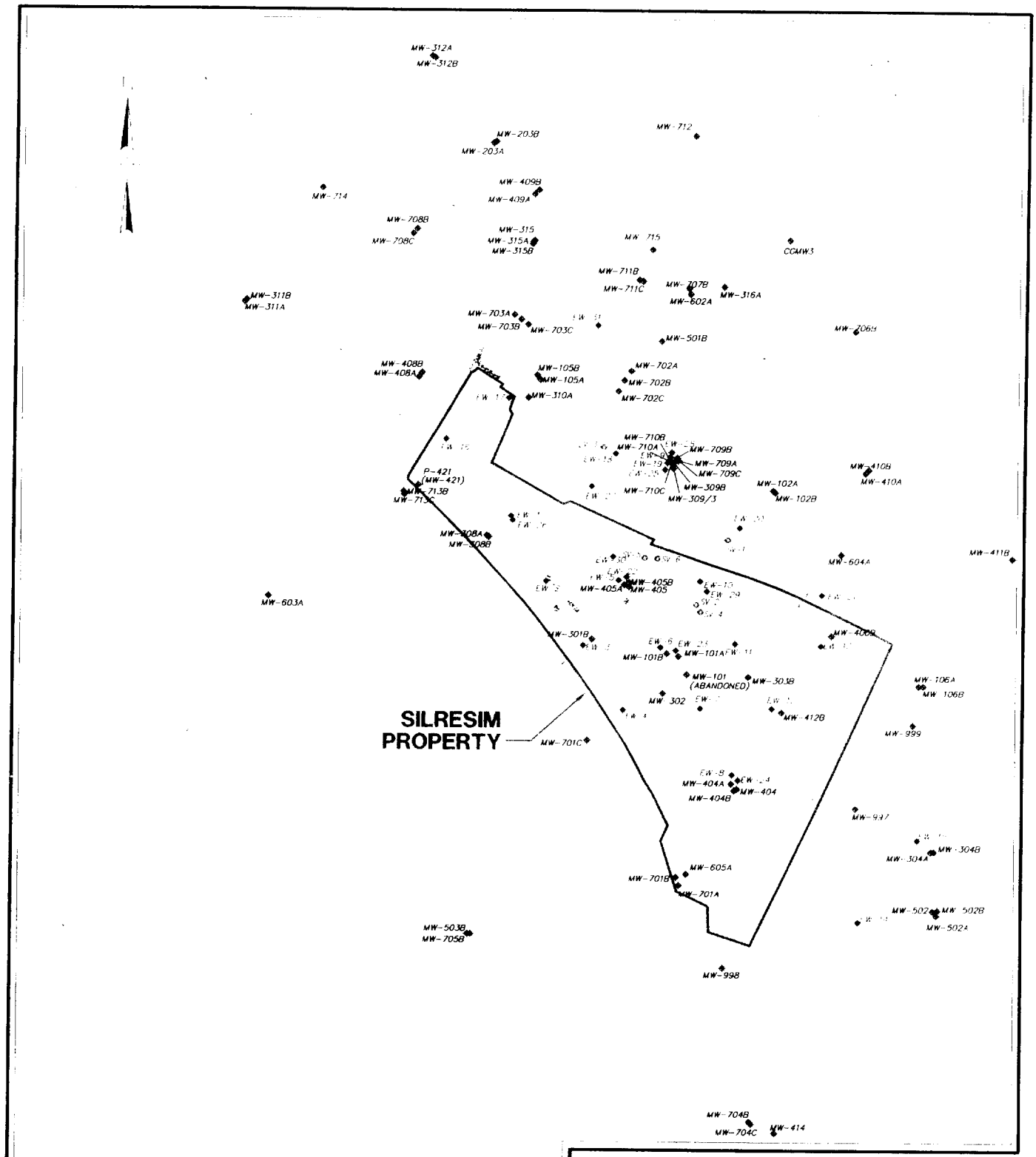
**SILRESIM SUPERFUND SITE**
**LOWELL, MASSACHUSETTS**

# SITE LOCATION MAP

**SCALE: AS SHOWN**

CADDFILE: SIL_LOCUS.DWG

# ATTACHMENT 2
# Silresim Site Area




# ATTACHMENT 2

SILRESIM SUPERFUND SITE
LOWELL, MASSACHUSETTS

## SILRESIM SITE AREA

SCALE: AS SHOWN

CADDFILE: 19a042.DWG

# ATTACHMENT 3
# List of Documents Reviewed

# ATTACHMENT 3

## List of Documents Reviewed


CDM, 1991. Supplemental Remedial Investigation, Silresim Site, November 1991.

Foster Wheeler, 1995a. Lowell Iron and Steel Property Soil Investigation Report - Silresim Superfund Site, Lowell, Massachusetts, December 1995.

Foster Wheeler, 1995b. Air Permeability Testing Data Report, Silresim Superfund Site, Lowell, Massachusetts, August 1995.

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Foster Wheeler, 2001. Child Recreation Exposure Assumptions, Draft Additional Site Investigation and Revision of Site Cleanup Goals Report, prepared by Foster Wheeler Environmental Corporation for the U.S. Army Corps of Engineers, New England Division, July 17, 2001.

Foster Wheeler, 2002. Final Additional Site Investigation and Revision of Site Cleanup Goals, Silresim Superfund Site, Lowell, Massachusetts, Volumes I and II, prepared by Foster Wheeler Environmental Corporation for the U.S. Army Corps of Engineers, New England Division, January 2002.

Foster Wheeler, 2003. Electrical Resistance Heating Pilot Test Final Report, Silresim Superfund Site, Lowell, MA, September 2003.

Goldberg-Zoino & Associates, Inc., 1990. Final Draft Report, Remedial Investigation, Silresim Site, Lowell, Massachusetts, March 1990.

MADEP, 2002. Indoor Air Sampling and Evaluation Guide, WSC Policy # 02-430, Office of Research Standards, April 2002.

MADEP, 2003. Proposed "Wave 2" Revisions to the MCP, Presentation from the Waste Site Cleanup Advisory Committee Meeting of December 2003, Draft Regulations, http://www.mass.gov/dep/bwsc/regs.htm, File wv2_1203.pdf

NCEA, 2001. External Review Draft – Trichloroethylene Health Risk Assessment: Synthesis and Characterization, U.S. Environmental Protection Agency, National Center for Environmental Assessment – Washington Office, EPA/600/P-01/002A, 2001.

Tetra Tech FW, 2004. Evaluation of Future Groundwater Flushing, Silresim Superfund Site, prepared by Tetra Tech FW for the U.S. Army Corps of Engineers, New England Division, March 2004.

USEPA, 1991. Record of Decision Summary, Silresim Superfund Site, Lowell, Massachusetts, U.S. Environmental Protection Agency Region I, September 1991.

USEPA, 1999. First Silresim Five-Year Review Report (Type IA), U.S. Environmental Protection Agency Region I, September 1999.

USEPA, 2001. Comprehensive Five-Year Review Guidance, Section 4.2, OSWER Directive 9355.7-03B-P, U.S. Environmental Protection Agency, Office of Environmental Policy and Guidance, June 2001.

USEPA, 2002. Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, November 29, 2002.

USEPA, 2003. Explanation of Significant Differences for the Silresim Chemical Corporation Superfund Site, Lowell, Massachusetts, U.S. Environmental Protection Agency, region I – New England, September 2003.

Watermark, 2003a. Status Report No. 22, Silresim Superfund Site, prepared by Watermark Environmental, Inc. for the USACE New England Division, June 2004.

Watermark, 2003b. Status Report No. 23, Silresim Superfund Site, prepared by Watermark Environmental, Inc. for the USACE New England Division, June 2004.

Wong-Yim, 2003. "Trichloroethylene Toxicity Criteria for Use at California Military Sites," memorandum from P. W. Wong-Yim, California EPA, Human and Ecological Risk Division to Stan Phillippe, Chief of the Office of Military Facilities, California EPA, February 19, 2003.

# ATTACHMENT 4
# Site Photographs

**Tetra Tech FW, Inc.**

**Silresim Superfund Site**
**USACE Contract No. DACW33-03-D-0006**
**Task Order No. 0003**

**PHOTOGRAPHIC RECORD**

**Photographer:** J. Scaramuzzo

**Date:** 6/8/04

**Time:** 12:30 P.M

**Frame No.:** 1

**Site Location:** Silresim

**Direction:** Southeast

**Comments:** Office trailer on right; GWTP in rear center; LI&S gantry on left.

**Silresim access gates from Tanner Street**

**Tetra Tech FW, Inc.**

**Silresim Superfund Site**
**USACE Contract No. DACW33-03-D-0006**
**Task Order No. 0003**

**PHOTOGRAPHIC RECORD**

**Photographer:** J. Scaramuzzo

**Date:** 6/8/04

**Time:** 12:30 P.M

**Frame No.:** 2

**Site Location:** Silresim

**Direction:** Southeast

**Comments:** Storage trailer is at left side of building. LUAP property can be seen to right side of utility pole.

**Silresim GWTP building taken from front of Silresim property**

**Tetra Tech FW, Inc.**

**Silresim Superfund Site**
**USACE Contract No. DACW33-03-D-0006**
**Task Order No. 0003**

**PHOTOGRAPHIC RECORD**

**Photographer:** J. Scaramuzzo

**Date:** 6/8/04

**Time:** 12:30 P.M.

**Frame No.:** 3

**Site Location:** Silresim

**Direction:** North

**Comments:** LI&S gantry and building are on right. LUAP property is on left.

**Silresim GWTP building taken from rear of Silresim property**

**Tetra Tech FW, Inc.**

**Silresim Superfund Site**
**USACE Contract No. DACW33-03-D-0006**
**Task Order No. 0003**

**PHOTOGRAPHIC RECORD**

**Photographer:** J. Scaramuzzo

**Date:** 6/8/04

**Time:** 12:30 P.M.

**Frame No.:** 4

**Site Location:** Silresim

**Direction:** Northwest

**Comments:** Tower air stripper is at left. Equilization discharge tank is at right.

**Interior of Silresim GWTP**

# ATTACHMENT 5
# Five-Year Review Site Inspection Checklist

# Five-Year Review Site Inspection Checklist (Template)

(Working document for site inspection. Information may be completed by hand and attached to the Five-Year Review report as supporting documentation of site status. "N/A" refers to "not applicable.")

## I. SITE INFORMATION

| | |
|---|---|
| **Site name:** SILRESIM SUPERFUND SITE | **Date of inspection:** 06/08/2004 |
| **Location and Region:** LOWELL, MA REGION I | **EPA ID:** MADCCC192393 |
| **Agency, office, or company leading the five-year review:** TETRA TECH FW, INC. | **Weather/temperature:** CLOUDY 70°F |

**Remedy Includes** (Check all that apply)

- Landfill cover/containment
- ✓ Access controls
- Institutional controls
- ✓ Groundwater pump and treatment
- Surface water collection and treatment
- Other
- Monitored natural attenuation
- ✓ Groundwater containment
- Vertical barrier walls

**Attachments:** Inspection team roster attached ✓ Site map attached in Report

## II. INTERVIEWS (Check all that apply)

1. **O&M site manager** JOHN HALEY/WATERMARK (Name) PROJECT MANAGER (Title) 06/08/04 (Date)
   Interviewed (at site) at office by phone Phone no.
   Problems, suggestions; Report attached

2. **O&M staff** STEVE DAIGLE/WATERMARK (Name) CHIEF OPERATOR (Title) 06/24/04 (Date)
   Interviewed (at site) at office by phone Phone no.
   Problems, suggestions; Report attached

3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

| | | | | |
|---|---|---|---|---|
| Agency | USEPA | | | |
| Contact | CHET JANUSKI | RPM | 6/8/04 | 617.918.1324 |
| | Name | Title | Date | Phone no. |

Problems, suggestions: Report attached

| | | | | |
|---|---|---|---|---|
| Agency | MADEP | | | |
| Contact | JANET WALDRON | RPM | 6/8/04 | 617.556.1156 |
| | Name | Title | Date | Phone no. |

Problems, suggestions, Report attached

| | | | | |
|---|---|---|---|---|
| Agency | | | | |
| Contact | | | | |
| | Name | Title | Date | Phone no. |

Problems, suggestions, Report attached

| | | | | |
|---|---|---|---|---|
| Agency | | | | |
| Contact | | | | |
| | Name | Title | Date | Phone no. |

Problems, suggestions, Report attached

4. **Other interviews** (optional) Report attached.

## III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

| | | | | |
|---|---|---|---|---|
| 1 | **O&M Documents** | | | |
| | ✓ O&M manual | ✓ Readily available | ✓ Up to date | N/A |
| | ✓ As-built drawings | ✓ Readily available | ✓ Up to date | N/A |
| | ✓ Maintenance logs | ✓ Readily available | ✓ Up to date | N/A |
| | Remarks | | | |
| 2. | **Site-Specific Health and Safety Plan** | ✓ Readily available | ✓ Up to date | N/A |
| | ✓ Contingency plan/emergency response plan | ✓ Readily available | ✓ Up to date | N/A |
| | Remarks | | | |
| 3. | **O&M and OSHA Training Records** | ✓ Readily available | ✓ Up to date | N/A |
| | Remarks | | | |
| 4 | **Permits and Service Agreements** | | | |
| | Air discharge permit | Readily available | Up to date | ✓ N/A |
| | Effluent discharge | ✓ Readily available | ✓ Up to date | N/A |
| | Waste disposal, POTW | ✓ Readily available | ✓ Up to date | N/A |
| | Other permits | Readily available | Up to date | N/A |
| | Remarks | | | |
| 5. | **Gas Generation Records** | Readily available | Up to date | ✓ N/A |
| | Remarks | | | |
| 6. | **Settlement Monument Records** | Readily available | Up to date | ✓ N/A |
| | Remarks | | | |
| 7. | **Groundwater Monitoring Records** | ✓ Readily available | ✓ Up to date | N/A |
| | Remarks | | | |
| 8. | **Leachate Extraction Records** | Readily available | Up to date | ✓ N/A |
| | Remarks | | | |
| 9. | **Discharge Compliance Records** | | | |
| | Air | ✓ Readily available | ✓ Up to date | N/A |
| | Water (effluent) | ✓ Readily available | ✓ Up to date | N/A |
| | Remarks | | | |
| 10. | **Daily Access/Security Logs** | ✓ Readily available | ✓ Up to date | N/A |
| | Remarks | | | |

## IV. O&M COSTS

**O&M Organization**

State in-house — Contractor for State
PRP in-house — Contractor for PRP
Federal Facility in-house — ✓ Contractor for Federal Facility
Other

**O&M Cost Records**

✓ Readily available — ✓ Up to date
Funding mechanism/agreement in place
Original O&M cost estimate $1.5 M — Breakdown attached

Total annual cost by year for review period if available

| | | | | |
|---|---|---|---|---|
| From 6/2003 Date | To 5/2004 Date | $1.2M Total cost | Breakdown attached |
| From 6/2002 Date | To 5/2003 Date | $1.2 M Total cost | Breakdown attached |
| From 6/2001 Date | To 5/2002 Date | $1.4 M Total cost | Breakdown attached |
| From 6/2000 Date | To 5/2001 Date | $1.5M Total cost | Breakdown attached |
| From 6/1999 Date | To 5/2000 Date | $1.5M Total cost | Breakdown attached |

**Unanticipated or Unusually High O&M Costs During Review Period**

Describe costs and reasons: N/A

## V. ACCESS AND INSTITUTIONAL CONTROLS — Applicable — N/A

**Fencing damaged** — ✓ Location shown on site map — ✓ Gates secured — N/A
Remarks Good Condition

**Access Restrictions**

**Signs and other security measures** — ✓ Location shown on site map — N/A
Remarks Good Condition

## C. Institutional Controls (ICs)

1. **Implementation and enforcement**

Site conditions imply ICs not properly implemented — Yes / No / ✓N/A
Site conditions imply ICs not being fully enforced — Yes / No / ✓N/A

Type of monitoring (*e.g.*, self-reporting, drive by) ____
Frequency ____
Responsible party/agency ____
Contact ____

| Name | Title | Date | Phone no. |
|---|---|---|---|

Reporting is up-to-date — Yes / No / N/A
Reports are verified by the lead agency — Yes / No / N/A

Specific requirements in deed or decision documents have been met — Yes / No / N/A
Violations have been reported — Yes / No / N/A
Other problems or suggestions: Report attached

Institutional controls are currently in the process of being evaluated and/or established by EPA in final remedy.

2. **Adequacy** — ICs are adequate / ICs are inadequate / N/A
Remarks ____

## D. General

1. **Vandalism/trespassing** — Location shown on site map / ✓No vandalism evident
Remarks ____

2. **Land use changes on site** ✓N/A
Remarks ____

3. **Land use changes off site** ✓N/A
Remarks ____

## VI. GENERAL SITE CONDITIONS

### A. Roads — ✓Applicable / N/A

1. **Roads damaged** — Location shown on site map / ✓Roads adequate / N/A
Remarks ____

**ite Conditions**

marks In general, S.K is in very good condition.

## VII. LANDFILL COVERS Applicable ~~N/A~~

**ill Surface**

**ttlement** (Low spots) Location shown on site map Settlement not evident
Areal extent Depth
marks

**acks** Location shown on site map Cracking not evident
engths Widths Depths
marks

**osion** Location shown on site map Erosion not evident
real extent Depth
marks

**oles** Location shown on site map Holes not evident
real extent Depth
marks

**egetative Cover** Grass Cover properly established No signs of stress
Trees/Shrubs (indicate size and locations on a diagram)
emarks

**Alternative Cover (armored rock, concrete, etc.)** N/A
marks

**ges** Location shown on site map Bulges not evident
al extent Height
Remarks

| | | | | |
|---|---|---|---|---|
| 8. | **Wet Areas/Water Damage** | Wet areas/water damage not evident | | |
| | Wet areas | Location shown on site map | Areal extent | |
| | Ponding | Location shown on site map | Areal extent | |
| | Seeps | Location shown on site map | Areal extent | |
| | Soft subgrade | Location shown on site map | Areal extent | |
| | Remarks | | | |
| 9. | **Slope Instability** | Slides | Location shown on site map | No evidence of slope instability |
| | Areal extent | | | |
| | Remarks | | | |
| **B. Benches** | | Applicable | N/A | |
| | (Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.) | | | |
| 1. | **Flows Bypass Bench** | Location shown on site map | N/A or okay | |
| | Remarks | | | |
| 2. | **Bench Breached** | Location shown on site map | N/A or okay | |
| | Remarks | | | |
| 3. | **Bench Overtopped** | Location shown on site map | N/A or okay | |
| | Remarks | | | |
| **C. Letdown Channels** | | Applicable | N/A | |
| | (Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.) | | | |
| 1. | **Settlement** | Location shown on site map | No evidence of settlement | |
| | Areal extent | Depth | | |
| | Remarks | | | |
| 2. | **Material Degradation** | Location shown on site map | No evidence of degradation | |
| | Material type | Areal extent | | |
| | Remarks | | | |
| 3. | **Erosion** | Location shown on site map | No evidence of erosion | |
| | Areal extent | Depth | | |
| | Remarks | | | |

**Undercutting** Location shown on site map No evidence of undercutting
Areal extent Depth
Remarks

**Obstructions** Type No obstructions
Location shown on site map Areal extent
Size
Remarks

**Excessive Vegetative Growth** Type
No evidence of excessive growth
Vegetation in channels does not obstruct flow
Location shown on site map Areal extent
Remarks

D. **Cover Penetrations** Applicable ✓ N/A

**Gas Vents** Active Passive
Properly secured/locked Functioning Routinely sampled Good condition
Evidence of leakage at penetration Needs Maintenance
N/A
Remarks

**Gas Monitoring Probes**
Properly secured/locked Functioning Routinely sampled Good condition
Evidence of leakage at penetration Needs Maintenance N/A
Remarks

**Monitoring Wells** (within surface area of landfill)
Properly secured/locked Functioning Routinely sampled Good condition
Evidence of leakage at penetration Needs Maintenance N/A
Remarks

4 **Leachate Extraction Wells**
Properly secured/locked Functioning Routinely sampled Good condition
Evidence of leakage at penetration Needs Maintenance N/A
Remarks

**Settlement Monuments** Located Routinely surveyed N/A
Remarks

**E. Gas Collection and Treatment** Applicable ✓N/A

1. **Gas Treatment Facilities**
   Flaring Thermal destruction Collection for reuse
   Good condition Needs Maintenance
   Remarks

2. **Gas Collection Wells, Manifolds and Piping**
   Good condition Needs Maintenance
   Remarks

3. **Gas Monitoring Facilities** (e.g., gas monitoring of adjacent homes or buildings)
   Good condition Needs Maintenance N/A
   Remarks

**F. Cover Drainage Layer** Applicable ✓N/A

1. **Outlet Pipes Inspected** Functioning N/A
   Remarks

2. **Outlet Rock Inspected** Functioning N/A
   Remarks

**G. Detention/Sedimentation Ponds** Applicable ✓N/A

1. **Siltation** Areal extent Depth N/A
   Siltation not evident
   Remarks

2. **Erosion** Areal extent Depth
   Erosion not evident
   Remarks

3. **Outlet Works** Functioning N/A
   Remarks

4. **Dam** Functioning N/A
   Remarks

## C. Treatment System

✓ Applicable N/A

1. **Treatment Train** (Check components that apply)
   - ✓ Metals removal
   - ✓ Air stripping
   - ✓ Filters Sand
   - ✓ Additive (e.g., chelation agent, flocculent) polymer, pH adjustment
   - ✓ Others Thermal Oxidizer
   - Oil/water separation
   - Carbon adsorbers
   - Bioremediation
   - ✓ Good condition
   - Needs Maintenance
   - ✓ Sampling ports properly marked and functional
   - ✓ Sampling/maintenance log displayed and up to date
   - ✓ Equipment properly identified
   - ✓ Quantity of groundwater treated annually ~ 6M gal
   - Quantity of surface water treated annually
   - Remarks All equipment in very good condition

2. **Electrical Enclosures and Panels** (properly rated and functional)
   - N/A
   - ✓ Good condition
   - Needs Maintenance
   - Remarks

3. **Tanks, Vaults, Storage Vessels**
   - N/A
   - ✓ Good condition
   - Proper secondary containment
   - Needs Maintenance
   - Remarks

4. **Discharge Structure and Appurtenances**
   - N/A
   - ✓ Good condition
   - Needs Maintenance
   - Remarks

5. **Treatment Building(s)**
   - N/A
   - ✓ Good condition (esp. roof and doorways)
   - ✓ Chemicals and equipment properly stored
   - Needs repair
   - Remarks

6. **Monitoring Wells** (pump and treatment remedy)
   - ✓ Properly secured/locked
   - ✓ Functioning
   - ✓ Routinely sampled
   - ✓ Good condition
   - ✓ All required wells located
   - Needs Maintenance
   - N/A
   - Remarks

## D. Monitoring Data

1. Monitoring Data
   - ✓ Is routinely submitted on time
   - ✓ Is of acceptable quality

2. Monitoring data suggests:
   - ✓ Groundwater plume is effectively contained
   - ✓ Contaminant concentrations are declining

**D. Monitored Natural Attenuation**

1 **Monitoring Wells** (natural attenuation remedy)

Properly secured/locked Functioning Routinely sampled Good condition

All required wells located Needs Maintenance ✓N/A

Remarks

## X. OTHER REMEDIES

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction. N/A

## XI. OVERALL OBSERVATIONS

**A. Implementation of the Remedy**

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

Management of Migration (MNM) Remedy is in place through active groundwater treatment system, and is functioning as designed, with continued adjustments to extraction scenario as required. All reporting is up to date and submitted to agencies for review and comment. Monthly meetings are held on site with representatives from USEPA, MADEP and USACE to discuss ongoing operations and make recommendations as necessary.

Also see report text

**B. Adequacy of O&M**

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

Operation of GWTP is adequate for intended remedy. Through enhanced modeling and physical observations, the operation may be (and has been in the past) optimized when opportunities exist and prove beneficial to the system. Currently, additional source control remedies are being evaluated and off-site contaminated surface soils are to be addressed through excavations (planned for fall 2004) as outlined in the ROD.

| C. | Early Indicators of Potential Remedy Problems |
|---|---|

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future

N/A

| D. | Opportunities for Optimization |
|---|---|

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

Site wide groundwater monitoring may be optimized through reductions in wells sampled, i.e. only most indicative monitoring wells (on periphery of system) may be sampled to reduce the overall sampling and analysis budgets and effort.

## INDIVIDUALS INTERVIEWED FOR THE SILRESIM SUPERFUND SITE FIVE-YEAR REVIEW

| Name/Position | Organization/Location | Date |
|---|---|---|
| John Haley<br>Site Manager | Watermark Environmental Inc. | 6/8/04 |
| Steve Daigle<br>GWTP Chief Operator | Watermark Environmental Inc. | 6/8/04 |
| Chet Janowski<br>EPA/RPM | U.S. EPA / Boston, MA | 6/8/04 |
| Janet Waldron<br>MADEP/PM | MADEP / Boston, MA | 6/8/04 |
| Laureen Borochaner<br>USACE/PM | USACE / Concord, MA | 6/8/04 |
| Dave O'Connor<br>USACE/Site Engineer | USACE / Devens, MA | 6/8/04 |

# ATTACHMENT 6
# Site CUGs for 2003 ESD

Table 1

RECOMMENDED CUGS FOR SURFACE SOIL

SILRESIM SUPERFUND SITE, LOWELL, MASSACHUSETTS

| Chemicals of Concern (1, 9) | Current Silresim Site ROD Cleanup Level (6) (mg/kg) | Commercial/Industrial Land Use: Risk-Based Clean-Up Goal for Surface Soil (2) (mg/kg) | MADEP Method 3 Upper Concentration Limit (3) (mg/kg) | Recommended Clean-Up Goal for Surface Soil (4) (mg/kg) | Basis for Recommended Clean-Up Goal |
|---|---|---|---|---|---|
| 1,1,2,2-Tetrachloroethane | 2.2 | 23 | 20 | 20 | MADEP UCL |
| Trichloroethene | 40 | 190 | 5,000 | 190 | Risk-Based CUG |
| 1,2,4-Trimethylbenzene | - | 73 | - | 73 | Risk-Based CUG |
| 1,3,5-Trimethylbenzene | - | 17 | - | 17 | Risk-Based CUG |
| Benzo(a)anthracene | 11 [7] | 50 | 100 | 50 | Risk-Based CUG |
| Benzo(a)pyrene | 11 [7] | 5 | 100 | 5 | Risk-Based CUG |
| Benzo(b)fluoranthene | 11 [7] | 50 | 100 | 50 | Risk-Based CUG |
| Dibenz(a,h)anthracene | 11 [7] | 5 | 100 | 5 | Risk-Based CUG |
| Hexachlorobenzene | - | 15 | 30 | 15 | Risk-Based CUG |
| 1,2,4-Trichlorobenzene | - | 18 | 10,000 | 18 | Risk-Based CUG |
| Arsenic | 21 | 30 | 300 | 30 | Risk-Based CUG |
| Lead | 500 | 448 | 6,000 | 448 | Risk-Based CUG |
| Mercury | - | 0.80 | 600 | 0.80 | Risk-Based CUG |
| 2,3,7,8-TetraCDD | 0.001 | 0.005 | 0.0002 | 0.0002 | MADEP UCL |
| Aroclor 1242 | 1 [8] | 13 | 100 | 13 | Risk-Based CUG |
| Aroclor 1254 | 1 [8] | 13 | 100 | 13 | Risk-Based CUG |

| Chemicals of Concern (5) | Current Silresim Site ROD Cleanup Level (6) (mg/kg) | Railroad Land Use: Risk-Based Clean-Up Goal for Surface Soil (2) (mg/kg) | MADEP Method 3 Upper Concentration Limit (3) (mg/kg) | Recommended Clean-Up Goal for Surface Soil (4) (mg/kg) | Basis for Recommended Clean-Up Goal |
|---|---|---|---|---|---|
| Arsenic | 21 | 110 | 300 | 110 | Risk-Based CUG |

Notes.

- = No MADEP Standard or current ROD Cleanup Level for this chemical, thus no value shown

(1) Tetrachloroethene, 1,1,2-Trichloroethane, Indeno(1,2,3-c,d)pyrene, Naphthalene, Thallium, and Aroclor 1248 were removed from the list shown on Table 6-48 in the Additional Site Investigation and Revision of Clean-Up Goals Report (Foster Wheeler, 2002) because the maximum detected concentration of these chemicals was less than the recommended clean-up goal. This is the same reasoning shown on Table 6-39 of the report except the recalculated clean-up goals and UCLs were used.

(2) Recommended CUGs assume a target risk goal of 1E-5 and a target hazard index of 1 for each chemical.

(3) MADEP UCLs (310 CMR 40.0996(7) Table 6) were included for comparison as a possible ARAR for the site.

(4) The most stringent of the risk-based CUG or UCL was taken as the recommended CUG for each chemical.

(5) Benzo(a)pyrene was removed from the list shown on Table 6-49 in the Additional Site Investigation and Revision of Clean-Up Goals Report (Foster Wheeler, 2002) because the maximum detected concentration of this chemical was less than the recommended clean-up goal. This is the same reasoning shown on Table 6-41 of the report except the recalculated clean-up goals and UCLs were used.

(6) Current Silresim Site Cleanup Level from Record of Decision Summary, September 19, 1991.

(7) Current ROD Cleanup Level for individual carcinogenic Polyaromatic Hydrocarbons (PAHs); Current Clean-Up Level for Total PAHs is 29 mg/kg.

(8) Current ROD Cleanup Level for Total Polychlorinated Biphenyls.

(9) The following chemicals have a Surficial Soil Cleanup Level under the current ROD, but did not warrant a CUG given the updated exposure and risk assessment (in mg/kg): Benzene (15); 1,1-Dichloroethene (0.72); 1,2-Dichloroethane (4.8); Methylene Chloride (58); and Styrene (14).

Table 2

RECOMMENDED CUGS FOR SUBSURFACE SOIL
SILRESIM SUPERFUND SITE, LOWELL, MASSACHUSETTS

| Chemicals of Concern (1, 8) | Commercial/Industrial Land Use | | | | |
|---|---|---|---|---|---|
| | Current Silresim Site ROD Cleanup Level (6) (mg/kg) | Risk-Based Clean-Up Goal for Subsurface Soil (2, 3) (mg/kg) | MADEP Method 3 Upper Concentration Limit (4) (mg/kg) | Recommended Clean-Up Goal for Subsurface Soil (5) (mg/kg) | Basis for Recommended Clean-Up Goal |
| Benzene | 0.004 | 0.04 | 2,000 | **0.04** | **Risk-Based CUG** |
| Chlorobenzene | 0.3 | 1.2 | 10,000 | **1.2** | **Risk-Based CUG** |
| Chloroform | 0.04 | 0.015 | 5,000 | **0.015** | **Risk-Based CUG** |
| 1,2-Dichloroethane | 0.001 | 0.031 | 600 | **0.031** | **Risk-Based CUG** |
| 1,1-Dichloroethene | 0.005 | 0.005 | 90 | **0.005** | **Risk-Based CUG** |
| Ethylbenzene | 6.8 | 1.2 | 10,000 | **1.2** | **Risk-Based CUG** |
| Methylene Chloride | 0.001 | 0.56 | 7,000 | **0.56** | **Risk-Based CUG** |
| Styrene | 0.17 | 290 | 1,000 | **290** | **Risk-Based CUG** |
| 1,1,2,2-Tetrachloroethane | 0.006 | 0.16 | 20 | **0.16** | **Risk-Based CUG** |
| Tetrachloroethene | - | 0.85 | 1,000 | **0.85** | **Risk-Based CUG** |
| Toluene | 2.7 | 11 | 10,000 | **11** | **Risk-Based CUG** |
| 1,1,1-Trichloroethane | 0.3 | 13 | 5,000 | **13** | **Risk-Based CUG** |
| 1,1,2-Trichloroethane | 0.003 | 0.12 | 100 | **0.12** | **Risk-Based CUG** |
| Trichloroethene | 0.006 | 0.25 | 5,000 | **0.25** | **Risk-Based CUG** |
| Vinyl Chloride | - | 0.0062 | 20 | **0.0062** | **Risk-Based CUG** |
| 1,2-Dichlorobenzene | 8.9 | 75 | 5,000 | **75** | **Risk-Based CUG** |
| Hexachlorobenzene | 0.034 | 6 | 30 | **6** | **Risk-Based CUG** |
| Naphthalene | - | 16 | 10,000 | **16** | **Risk-Based CUG** |
| 1,2,4-Trichlorobenzene | 0.72 | 1 | 10,000 | **1** | **Risk-Based CUG** |
| Lead | - | 448 | 6,000 | **448** | **Risk-Based CUG** |
| Mercury | - | 0.77 | 600 | **0.77** | **Risk-Based CUG** |
| 2,3,7,8-TetraCDD | 0.001 | 0.005 | 0.0002 | **0.0002** | **MADEP UCL** |
| Aroclor 1242 | 2.3[7] | 13 | 100 | **13** | **Risk-Based CUG** |

Notes:

- = No current ROD Cleanup Level for this chemical, thus no value shown.

(1) 1,2,3-Trichlorobenzene, 1,2,4-Trimethylbenzene, 1,3,5-Trimethylbenzene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Dibenz(a,h)anthracene, 1,4-Dichlorobenzene, and Thallium were removed from the list shown on Table 6-50 in the Additional Site Investigation and Revision of Clean-Up Goals Report (Foster Wheeler, 2002) because the maximum detected concentration of these chemicals was less than the recommended clean-up goal. This is the same reasoning shown on Table 6-46 of the report except the recalculated clean-up goals and UCLs were used.

(2) Recommended CUGs assume a target risk goal of 1E-5 and a target hazard index of 1 for each chemical.

(3) Subsurface Soil includes only unsaturated subsurface soil, assumed to be between 1 ft below ground surface (bgs) and 10 ft bgs.

(4) MADEP UCLs (310 CMR 40.0996(7) Table 6) were included for comparison as a possible ARAR for the site.

(5) The more stringent of the risk-based CUG or UCL was taken as the recommended CUG for each chemical.

(6) Current Silresim Site Cleanup Level from Record of Decision Summary, September 19, 1991.

(7) Current ROD Cleanup Level for Total Polychlorinated Biphenyls.

(8) The following chemicals have an Unsaturated Soil Cleanup Level under the current ROD, but did not warrant a CUG given the updated exposure and risk assessment (in mg/kg): Carbon Tetrachloride (0.005); Bis(2-ethylhexyl)phthalate (0.30); 1,2-Dichloropropane (0.003); Individual carcinogenic PAHs (10); trans-1,2-Dichloroethene (0.067); Phenol (5.3); 2-Butanone (0.06); and Xylenes (22).

Table 3
RECOMMENDED CUGS FOR GROUNDWATER
SILRESIM SUPERFUND SITE, LOWELL, MASSACHUSETTS

| Chemicals of Concern (1, 6) | Commercial/Industrial Land Use | | | | | |
|---|---|---|---|---|---|---|
| | Current Silresim Site ROD Cleanup Level (5) (mg/L) | Risk-Based Clean-Up Goal for Groundwater (2) (mg/L) | MADEP Method 1 GW-3 Standard (3) (mg/L) | MADEP Method 3 Upper Concentration Limit (3) (mg/L) | Recommended Clean-Up Goal for Groundwater (4) (mg/L) | Basis for Recommended Clean-Up Goal |
| Acetone | - | - | 50 | 100 | 50 | GW-3 Standard |
| Benzene | 0.005 | 0.48 | 7 | 70 | 0.48 | Risk-Based CUG |
| Chlorobenzene | 0.1 | 4.9 | 0.5 | 10 | 0.5 | GW-3 Standard |
| Chloroform | 0.1 | 0.2 | 10 | 100 | 0.2 | Risk-Based CUG |
| 1,2-Dichloroethane | 0.005 | 0.5 | 50 | 100 | 0.5 | Risk-Based CUG |
| 1,1-Dichloroethene | 0.007 | 0.015 | 50 | 100 | 0.015 | Risk-Based CUG |
| 1,2-Dichloroethene (total) | - | 120 | - | - | 120 | Risk-Based CUG |
| cis-1,2-Dichloroethene | - | - | 50 | 100 | 50 | GW-3 Standard |
| Ethylbenzene | 0.7 | 3.4 | 4 | 100 | 3.4 | Risk-Based CUG |
| Hexachlorobutadiene | - | 0.041 | 0.09 | 0.9 | 0.041 | Risk-Based CUG |
| Methylene Chloride | 0.005 | 14 | 50 | 100 | 14 | Risk-Based CUG |
| 1,1,2,2-Tetrachloroethane | 0.005 | 0.61 | 20 | 100 | 0.61 | Risk-Based CUG |
| Tetrachloroethene | - | 5.9 | 5 | 50 | 5 | GW-3 Standard |
| 1,2,3-Trichlorobenzene | - | 3.8 | - | - | 3.8 | Risk-Based CUG |
| 1,1,1-Trichloroethane | 0.2 | 120 | 50 | 100 | 50 | GW-3 Standard |
| 1,1,2-Trichloroethane | 0.005 | 1.1 | 50 | 100 | 1.1 | Risk-Based CUG |
| Trichloroethene | 0.005 | 1.4 | 20 | 100 | 1.4 | Risk-Based CUG |
| Vinyl Chloride | - | 0.13 | 40 | 100 | 0.13 | Risk-Based CUG |
| Naphthalene | - | 0.89 | 6 | 60 | 0.89 | Risk-Based CUG |
| 1,2,4-Trichlorobenzene | 0.009 | 0.15 | 0.5 | 100 | 0.15 | Risk-Based CUG |
| Arsenic | 0.05 | - | 0.4 | 3 | 0.4 | GW-3 Standard |
| Cadmium | 0.005 | - | 0.01 | 0.1 | 0.01 | GW-3 Standard |
| Lead | 0.015 | - | 0.03 | 0.3 | 0.03 | GW-3 Standard |
| Nickel | 0.1 | - | 0.08 | 1 | 0.08 | GW-3 Standard |

Notes:

- = No MADEP Standard or current ROD Cleanup Level for this chemical, thus no value shown.

(1) 1,1-Dichloroethane, Styrene, Toluene, and 1,2-Dichlorobenzene were removed from the list shown on Table 6-51 in the Additional Site Investigation and Revision of Clean-Up Goals Report (Foster Wheeler, 2002) because the maximum detected concentration of these chemicals was less than the recommended clean-up goal. Likewise, Acetone, cis-1,2-Dichloroethene, Arsenic, Cadmium, Lead, and Nickel were added to the same list because the maximum detected concentration of these chemicals was greater than the recommended clean-up goal. This is the same reasoning shown on Table 6-47 of the report except the recalculated clean-up goals, GW-3 standards, and UCLs were used.

(2) Recommended CUGs shown are calculated with a target risk goal of 1E-5 and a target hazard index of 1 for each chemical.

(3) MADEP GW-3 Standards (310 CMR 40.0974(2) Table 1) and UCLs (310 CMR 40.0996(7) Table 6) were included for comparison as a possible ARAR for the site.

(4) The most stringent of the risk-based CUG, GW-3 Standard or UCL was taken as the recommended CUG for each chemical.

(5) Current Silresim Site Cleanup Level from Record of Decision Summary, September 19, 1991.

(6) The following chemicals have an Interim Ground Water Cleanup Level under the current ROD, but did not warrant a CUG given the updated exposure and risk assessment (in mg/kg): Bis(2-ethylhexyl)phthalate (0.004); Carbon Tetrachloride (0.005); 1,2-Dichloropropane (0.005); Dioxin (5.0 x 10-11); Hexachlorobenzene (0.001); Individual Carcinogenic PAHs (0.0002); PCBs (0.0005); Styrene (0.10); 2-Butanone (0.35); Chromium [+3] (0.10); Copper (1.3); 1,2-Dichlorobenzene (0.60); trans-1,2-Dichloroethene (0.10); Phenol (21); Selenium (0.050); Toluene (1.0); and Xylenes (10).

# ATTACHMENT 7
# Site ARARs

## Silresim Superfund Site
## New Applicable or Relevant and Appropriate Requirements (ARARs)

| Medium/Authority | ARAR | Status | Requirement Synopsis | Action to be Taken to Attain ARAR |
|---|---|---|---|---|
| Groundwater & Soil/Federal | USEPA – Office of Solid Waste & Emergency Response (OSWER) No. 9285.7-02EP: Risk Assessment Guidance for Superfund – Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), September 2001 | To Be Considered | Provides a consistent methodology for assessing the dermal pathway for Superfund human health risk assessments. | Will apply this guidance in the calculation of risk-based Benchmark Assessment Values, which will be the principal components of the revised CUGs. |
| Soil/Federal | USEPA – OSWER No. 9285.7-54: Recommendations of the Technical Review Workgroup for Lead for an Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil, January 2003 | To Be Considered | Describes a methodology for assessing risks associated with non-residential adult exposures to lead in soil. This is a generic methodology that could be adapted for use in site-specific assessments. Also provides tools that can be used for evaluating risks of elevated blood lead concentrations among exposed adults. | Will apply this guidance in the calculation of risk-based Benchmark Assessment Values, which will be the principal components of the revised CUGs. |
| Soil & Groundwater/Federal | USEPA – Office of Research & Development, No. EPA/600/P-96/001F: PCBs: Cancer Dose-Response Assessment and Application to Environmental Mixtures, September 1996 | To Be Considered | Updates the cancer dose-response assessment for PCBs and shows how information on toxicity, disposition, and environmental processes can be considered together to evaluate health risks from PCB mixtures in the environment. This report is to be used to support risk-based decisions within the general policy framework provided by applicable EPA statutes and does not alter such policies. | Will apply this guidance in the calculation of risk-based Benchmark Assessment Values, which will be the principal components of the revised CUGs. |
| Air/Federal | USEPA – Office of Solid Waste, No. EPA530F-02-052: Evaluating the Vapor Intrusion into Indoor Air, November 2002 | To Be Considered | Provides current technical and policy recommendations on determining if the vapor intrusion pathway poses an unacceptable risk to human health at cleanup sites. | Will apply this guidance in the calculation of risk-based Benchmark Assessment Values, which will be the principal components of the revised CUGs. |

| Medium/Authority | ARAR | Status | Requirement Synopsis | Action to be Taken to Attain ARAR |
|---|---|---|---|---|
| Air/State | Massachusetts Department of Environmental Protection – Office of Research and Standards, WSC Policy No. 02-430: Indoor Air Sampling and Evaluation Guide, April 2002 | To Be Considered | Provides an overview of considerations involved in planning and executing an indoor air sampling study and evaluating its results. Intended as a tool for conducting indoor air evaluations under the MCP. Contains the risk assessment and risk management methodologies used to conduct risk assessment consistent with MCP protocols. | Will apply this guidance in the calculation of risk-based Benchmark Assessment Values, which will be the principal components of the revised CUGs. |
| Soil/Federal | USEPA – OSWER No. 9355.4-24: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, December 2002 | To Be Considered | Provides a tiered framework for developing risk-based, site-specific soil screening levels (SSLs), which are used to identify areas, chemicals, and pathways of concern at NPL sites. The three-tiered framework includes a set of conservative, generic SSLs, a simple site-specific approach for calculating SSLs, and a detailed site-specific modeling approach for more comprehensive consideration of site conditions in establishing SSLs. | Will apply this guidance in the calculation of risk-based Benchmark Assessment Values, which will be the principal components of the revised CUGs. |
| Soil/Federal | USEPA – OSWER Directive No. 9200.4-26 Memorandum: Approach for Addressing Dioxin in soil at CERCLA and RCRA Sites, April 13, 1998 | To Be Considered | Recommends preliminary remediation goals (PRGs) or starting points for setting cleanup levels for dioxin in soil at CERCLA and RCRA sites. Sets forth the policy basis for these recommended levels and prescribes procedures for implementing these recommendations. One ppb (TEQs, or toxicity equivalents) is to be generally used as a starting point for setting cleanup levels for CERCLA removal sites and as a PRG for remedial sites for dioxin in surface soil involving a residential exposure scenario. For commercial/industrial exposure scenarios, a soil level within the range of 5 ppb to 20 ppb (TEQs) should generally be used as a starting point for setting cleanup levels at CERCLA removal sites and as a PRG for remedial sites for dioxin in surface soil. | Will use the recommended levels as CUGs. |

# ATTACHMENT 8
# Silresim Historical Archive

SILRESIM SUPERFUND SITE
HISTORICAL ARCHIVE - REFERENCE SECTION

Last Updated: July 13, 2004

The following reports / documents are included in the public file for the Silresim Superfund Site:

| | |
|---|---|
| • Record of Decision (ROD) Summary | September 1991 |
| • Basis of Design / Design Analysis | February 1994 |
| • Air Permeability Testing Data Report | August 1995 |
| • Lowell Iron & Steel Property Soil Investigation Report | December 1995 |
| • Soil Vapor Extraction (SVE) Pilot Test Report | August 1997 |
| • ROD Remedy Review | July 1999 |
| • Phase I SVE Summary Report | February 2000 |
| • Pathways Analysis Report | February 2001 |
| • Electrical Resistance Heating Pilot Test Final Report | September 2003 |
| • Explanation of Significant Differences | September 2003 |
| • Final Baseline Groundwater Monitoring Report | May 1996 |
| • Groundwater Monitoring Program Year – 1 – Review | July 1997 |
| • Groundwater Monitoring and Treatment System O&M Status Report #1 | Nov. 6, 1995 – Feb. 6, 1996 |
| • Status Report #2 | Feb. 7, 1996 – May 6, 1996 |
| • Status Report #3 | May 7, 1996 – Aug. 6, 1996 |
| • Status Report #4 | Aug. 7, 1996 – Nov. 6, 1996 |
| • Status Report #5 | Nov. 7, 1996 – Feb. 6, 1997 |
| • Status Report #6 | Feb. 7, 1997 – May 6, 1997 |
| • Status Report #7 | May 7, 1997 – Aug. 6, 1997 |
| • Status Report #8 | Aug. 7, 1997 – Nov. 6, 1997 |
| • Status Report #9 | Nov. 7, 1997 – Feb. 6, 1998 |
| • Status Report #10 | Feb. 7, 1998 – May 6, 1998 |
| • Status Report #11 | May 7, 1998 – Aug. 6, 1998 |
| • Status Report #12 | Aug. 7, 1998 – Nov. 6, 1998 |
| • Status Report #13 | Nov. 7, 1998 – Feb. 6, 1999 |
| • Status Report #14 | Feb. 7, 1999 – May 5, 1999 |
| • Status Report #15 | May 6, 1999 – Nov. 5, 1999 |
| • Status Report #16 | Nov. 6, 1999 – Feb. 5, 2000 |
| • Status Report #17 | Feb. 6, 2000 – Aug. 5, 2000 |
| • Status Report #18 | Aug. 6, 2000 – Feb. 5, 2001 |
| • Status Report #19 | Feb. 6, 2001 – Aug. 5, 2001 |
| • Status Report #20 | Aug. 6, 2001 – Feb. 5, 2002 |
| • Status Report #21 | Feb. 6, 2002 – Aug. 5, 2002 |
| • Status Report #22 | Aug. 6, 2002 – Feb. 5, 2003 |
| • Status Report #23 | Feb. 6, 2003 – Aug. 5, 2003 |